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TO ADVERTISERS

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NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

On Friday, August 16, the wireless telegraph system for announcing the arrival in American waters of transatlantic vessels provided with proper sending apparatus was successfully inaugurated. The Nantucket Shoals lightship, anchored some 35 miles to the southeast of the island of Nantucket, has been equipped with Marconi apparatus, and a station has also been erected at Siasconset, on Nantucket. The latter is connected by telephone and telegraph with the mainland. On the evening in question, the steamship Lucania, being then off the lightship, reported her arrival and exchanged several messages with the shore. This is one of the most interesting and really important applications that wireless telegraphy has received, as it enables incoming steamships to be reported twelve to eighteen hours before they arrive at New York. This will often enable business arrangements to be made in advance and be of great value to the commercial community.

PEREGRINATIONS OF THE CENTRAL STATION.

When electric lighting was first introduced into American cities it was distributed from small stations placed as closely as possible to the centres of light distribution, and when it was found necessary to cover an area larger than could economically be handled from one of these an auxiliary station was built.

The invention of the three-wire system practically quadrupled the radius which could be supplied from a single station, thus making it possible to remove the stations somewhat away from the immediate centre of distribution, but still not enabling it to go very far from this region, which also generally was the centre of business activity in the town. Naturally, the centre of business activity is the place of all others where rents and real estate values are highest, and most often it is furthest from and least convenient to sources of coal and water supply. For all these reasons the early stations were no little handicapped, although their business was never large enough to make absolutely necessary the detailed economies which are practiced in the great plants of to-day.

No sooner had the polyphase system well established itself in the regard of engineers than it was applied to the difficult problem of lighting large urban areas from a single source of power supply. In Chicago, in New York, in Philadelphia, in Brooklyn, in Boston and in many other cities, the central stations are often many miles distant from the centres which they supply. Current is generated at high pressure and fed by transmission lines of great economy to distributing points, where it is transformed and converted to fit it for its use on the distributing network. It has been found convenient and satisfactory in many of these cities to move the station to points convenient for coal supply and at the same time having an abundance of water for condensing and other purposes. This has dictated their location along the water-front in some of the cities named, and has resulted in extraordinary economies, the additional loss imposed by the increased transmission distance being practically negligible.

No doubt exists in the minds of engineers to-day of the entire feasibility of operating, for example, the entire lighting of Greater New York from a single great station, should this be desirable. Under local conditions, and with cheaper water deliveries for coal, it is not likely that it would be desirable; but the fact that central stations have moved even three or four times, and each time moved further away from the centres which they supply, leads to the interesting speculation of how far and in what direction they will go next.

For our eastern coast cities, situated within reasonable transmission distance of the great coal fields of the Appalachian mountains, it seems natural to believe that the next important move of these stations will be to the coal pits. Every increase in facilities for power transmission to great distances adds a new factor to the economic equation which must in the end determine all such matters as the location of power-generating plants. At present it is believed that the copper wire line and the coal train are practically equal in efficiency for the transmission of power to distances between one hundred and two hundred miles. What the future has in store for electric transmission can not easily be guessed at, but viewing the progress that has been made in the last few years, and seeing that each step forward makes it possible to increase transmission distances, while retaining commercial efficiency of operation, it looks as if the day was not incalculably distant when the engines for driving the electric lights of New York and Philadelphia would be located at the coal mines in the mountains to the west.

Were such an innovation to be made, and were power to be delivered to New

York in vast quantities over such a line, it would undoubtedly find use for many other purposes than electric lighting, and the result would be a great stride toward the smokeless city. It is interesting to note that present-day engineering is entirely able to cope with the problem of transmitting very large power from these coal fields to New York. The only question that remains to be solved is: Will this pay in comparison with transporting the coal by railroad from the mines and burning it under boilers in the city?

THE LONG-DISTANCE TROLLEY.

The electric railway—that is, the ordinary trolley road—has been so completely standardized that of late little advance has been made in connection with its equipment. It is true that road-beds have become better as the necessity for improved track has become more widely recognized, but the equipment itself has remained very nearly standard except in the matter of line distribution.

But the trolley seems destined to play its part in two epochs of development. It was not so long ago that the horse was prominent as the means of transit in cities, and it will be remembered that when the first trolley cars had successfully held their own against horse traction that the movement to equip existing street car lines with electricity, and to build new electric lines here and there in towns, was one of the most remarkable in industrial history. Perhaps nothing like it has been seen since the railway building craze in Great Britain in the early thirties. In five or six years from the time of the commercial introduction of the electric street railway system there were nearly one thousand street railway companies in the United States alone operating electric cars.

The trolley line having been built practically in all of the towns where it seemed to have any chance to earn its way, naturally the construction of electric railways took on the complexion of any other steady and stable industry and the growth of these lines was measured in some degree by the ordinary growth of the country. But it soon came to be seen that the system which worked so perfectly on the streets was equally capable of extension into the country, and that where cities and towns were close together a good local traffic could be had by uniting two or more places.

Slowly the interurban railway began to stretch out from town to town, forming a network which has grown until in some regions, as in New England, for example, all the important centres are connected, and one may travel often as much as one hundred or two hundred miles in one direction in the cars of various street and interurban railway companies.

Naturally, such a state of things inevitably attracted the attention of exploiters, and the natural genius for consolidation which the American people seem to possess exerted itself. On every hand now we hear of consolidation of interurban street railway systems, until companies, in some cases, possess straightaway lines more than two hundred miles long. The next step, naturally, is the unification of construction throughout, the improvement of rights of way and permanent way, and then the operation of through cars.

In the last few days plans for the construction of trolley roads from Albany to Boston, from Albany to Buffalo, and from New York to Albany, from New York to Boston, from New York to Philadelphia, from Cincinnati to Toledo and Detroit, and in innumerable other places, have been made the subject for discussion in the newspapers. It is believed that some, if not all, of these lines will actually be built and several of them can be organized simply by the consolidation of existing properties and the construction of relatively short links.

The subject is particularly fascinating. Here we have the unacknowledged rival of the steam railway growing in importance and in size, slowly but surely, and in disjointed units; when suddenly these are amalgamated to form a system that not only parallels the lines of existing steam railroads in many sections, but which actually surpasses them in extent and utility. The next year or two will see a comparatively bitter struggle for supremacy in many parts of this country between the railroads and the trolley roads. The latter have all of the benefits of cheap construction and low expense of operation and of convenience. The only remedy left for the railroads is to electrify their own tracks and to turn themselves forthwith into magnified and superior trolley lines.

THE INSTITUTE CONVENTION.

The eighteenth annual convention of the American Institute of Electrical Engineers has begun under most pleasant circumstances, and will continue this week its sessions at Buffalo. The attendance at the opening meeting in New York, on August 14, was unexpectedly large and highly gratifying. The programme that had been arranged by the committees on reception and entertainment was very attractive, and all who participated seemed to enjoy the occasion.

This meeting has been more international in character than any other the Institute has ever had. Delegates from sister societies and guests were present from Great Britain, France, Germany, South Africa, Japan and elsewhere.

Of especial interest were the visits made on Thursday and Friday, the first day to the Crocker-Wheeler works and the New York Telephone Company's magnificent exchange in Eighteenth street, and by boat to the water-front power stations in New York and Brooklyn. The foreign visitors seemed heartily to enjoy these visits and saw much that interested them. The magnitude of the great stations seemed peculiarly to impress them, as did also the prominence in American life of features depending upon engineering works. The regular programme which will be taken up in Buffalo, on Tuesday, is of high interest, and it is expected that this meeting will be by all odds the most interesting, significant and important that the Institute has enjoyed in its history.

To appreciate the advantages of electricity over steam as a motive power one has only to take a short trip on a hot day upon some of the surface cars in New York city, which are driven by electricity, and then return by an elevated train drawn by a steam locomotive. In the latter case, although hard coal is burned, more or less of the gases—generally more—is always being blown or drawn through the cars by the motion of the train, when all the windows and doors are open, which is not at all conducive to the comfort of the occupants. The equipment of all the elevated lines with electricity, which is now taking place, will be an unspeakable blessing to the thousands who go to their business in the morning and return in the evening by them.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XL.

BY W. ELWELL GOLDSBOROUGH.

The numerous construction lines which the graphical solution necessitates makes it somewhat difficult to follow through Fig. 108 to the point of locating the final vector resultants. That the final conditions which obtain in the circuit may be more easily seen, the important vectors have been transferred and reproduced in Fig. 109. In this figure the point O′ is

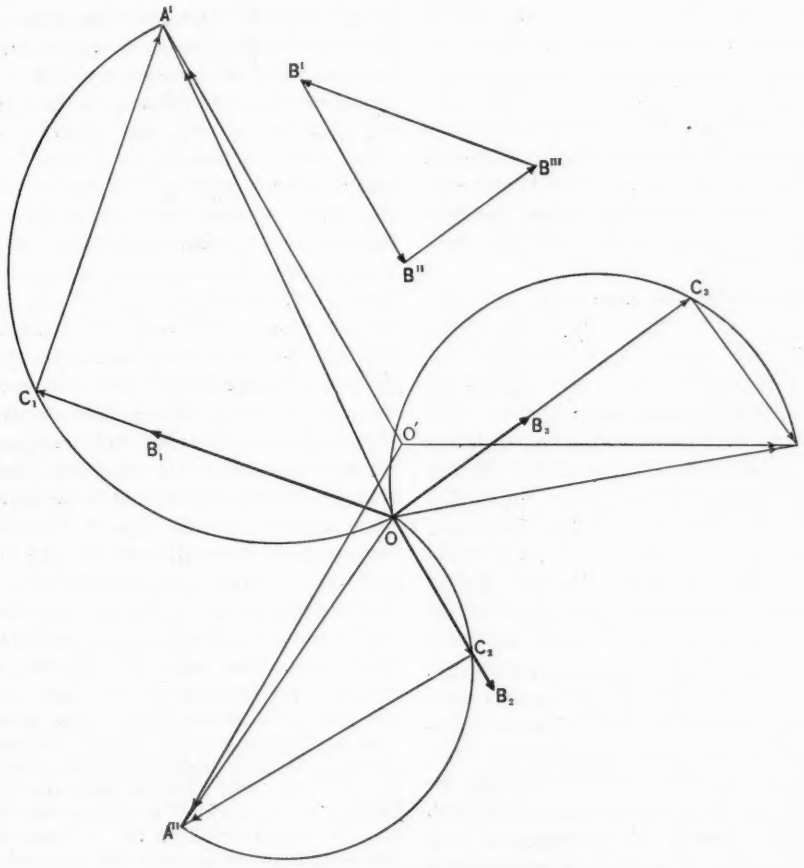


FIG. 109.—ALTERNATING MECHANISMS.

the junction point of the heels of the vectors representing the electro-motive forces developed by the three alternators working synchronously. The point O is the junction of the heels of the vectors representing the three electro-motive forces that are impressed upon the three independent circuits of Fig. 104, as well as the junction point of the heels of the vectors which represent the currents flowing in these three circuits.

$O'A^I$ of Fig. 109, therefore, represents the electro-motive force E^I; $O'A^{II}$, the electro-motive force E^{II}, and $O'A^{III}$, the electro-motive force E^{III}. Further, since the head of the vector representing the electro-motive force of alternator E^I and the head of the vector the electro-motive force impressed upon the circuit A_1O meet in a common point, OA^I is the electro-motive force which appears between the terminal points A_1 and O of Fig. 104. For the same reason OA^{II} represents the electro-motive force appearing at the terminals A_2O of Fig. 104, and OA^{III} the electro-motive force at the terminals of the third circuit of Fig. 104.

Upon these latter electro-motive-force vectors we will now construct the triangles of electro-motive forces of the three circuits. Since the values of the resistance and reactance of the first circuit are known, and the value of the current in the first circuit determined (Fig. 108), we can lay off the vector OC_1 lagging behind the vector OA^I by an angle equal to

$$\phi_1 = \tan^{-1}\frac{x_1}{r_1}$$

and give to OC_1 a length equal to I_1r_1. Further, on OC_1, we can lay off the distance OB_1 equal to I_1 as determined from Fig. 108.

By comparing Figs. 109 and 108 we now find that the current vector OB_1 of Fig. 109 is parallel to the vector $B_1{}^IB_1$ of Fig. 108. In completing the triangle of the electro-motive forces of the circuit A_1O, we erect at C_1 the vector C_1A^I perpendicular to the vector OC_1. The length C_1A^I is equal to the product I_1x_1.

The electro-motive-force triangle of the second circuit is, in like manner, constructed upon the electro-motive-force vector OA^{II}. In this case we can lay off the semi-circle OC_2A^{II} on OA^{II} as a diameter; then, from the point O as a centre and with a radius equal to I_2r_2, the point C_2 can be determined. The distance C_2A^{II} is now equal to the product I_2x_2. If in the direction OC_2 we lay off the distance OB_2 equal in length to the vector $B_2{}^{II}B_2$ of Fig. 108, OB_2 will represent the current flowing in the second circuit, since it will be found to be parallel to the vector $B_2{}^{II}B_2$ of Fig. 108.

In the case of the third circuit the heel of its electro-motive-force triangle C_3 can be determined by taking the intersection of two circles, one of them being described from O as a centre with a radius equal to $I_3r_3 = OC_3$, Fig. 109, and the other being described from A^{III} as a centre with a radius equal to $I_3x_3 = C_3A^{III}$. In the latter case, the point C_3, of course, follows on the semi-circle OC_3A^{III} and the angle C_3OA^{III} equals

$$\phi_3 = \tan^{-1}\frac{x_3}{r_3}.$$

The construction of Fig. 109 gives us a very clear and simple presentation of the conditions which exist in an unbalanced three-phase system. The impressed electro-motive forces appear as independent vectors. The resultant electro-motive forces acting directly on the three circuits are each the hypotenuse of an electro-motive-force triangle that is graphically independent of the impressed electro-motive forces.

The currents can either be drawn in the vector positions in which they are shown in Fig. 109, or their junction can be transferred to the point O′. In the latter case they are drawn with reference to the alternator electro-motive forces instead of with reference to the line electro-motive forces.

In the same manner, as the electro-motive-force vectors of the system form a closed polygon, the vectors of the currents present in the system also form a closed polygon. This means that any one of the three-line currents is equal to the resultant of the other two. That this is true is shown in the figure bounded by the points $B^IB^{II}B^{III}$ of Fig. 109. The vectors here shown are drawn parallel and equal to the current vectors of the main figure and form, accordingly, a closed polygon. OB_1 is equal and parallel to $B^{III}B^I$, OB_2 equal and parallel to B^IB^{II} and OB_3 equal and parallel to $B^{II}B^{III}$.

Science Brevities

Propagation of Electric Waves in Water—Mr. C. Guton has an interesting paper on the above subject in *Science Abstracts* for July. When the electric and magnetic properties of an insulator depend only upon its dielectric constant, the wave-length of the resonator remains the same when measured as in air and then in the insulating medium in question. This proposition was adduced by Blondlot from considerations of homogeneity and verified in the cases of castor oil and ice. If the medium is magnetic or conducting, or if it shows considerable absorption for electric waves, its properties are no longer completely defined by its dielectric constants and the equality of wave-lengths of the resonator in air and in the medium can not be certain. This is the case with ordinary spring water, which shows a decided conductivity and consequent absorption of electric waves. He measured the wave-lengths of the simple resonator in air and in water and found that they were practically the same when resonator and wires were either out in the air or immersed in water. He found also that the path traversed by the waves during one period of the resonator oscillating in air is 8.3 times smaller in water than in air. This implies that when a resonator is plunged into water its period of oscillation becomes 8.3 times greater than in air.

Fire-Damp Indicated by Electricity—M. G. Léon has devised a novel fire-damp indicator, based upon the method of electrical resistance. The halo given by the flame in the air containing fire-damp is the basis of the indicators in use at present. Ordinary oil, safety lamps will only indicate down to two per cent, but M. Pieler, using the larger flame of alcohol, has brought the limit down to two or three-thousandths. M. Chesneau dissolves nitrate of copper and bichloride of ethylene in the alcohol and gives a blue flame to the Pieler lamp, which reveals as low as one-thousandth part of fire-damp. Mr. Livéing, an English engineer, has devised an electric indicator based on the difference in redness of two platinum wires heated by the same current and placed in pure and in contaminated air. This method will show about one-half per cent. In the present method, M. Léon uses instead the difference of electric resistance of two platinum wires heated to about 1,000 degrees centigrade by the same current. One of the wires is stretched in a sealed glass tube, and the other (for the fire-damp), placed in a wire gauze case. The two wires form the two branches of a Wheatstone bridge, the other two branches being formed of suitable resistance wires, in this case of 1.3 ohms each. For the galvanometer of the bridge a Chauvin & Arnoux instrument was used, giving a deflection of 100 divisions for 50 milliamperes. Two cells of accumulator give the current, and the resistances are adjusted till the needle remains at zero when both wires are in pure air. When the air contains fire-damp, the galvanometer is deflected two divisions for one-thousandth part of fire-damp. These deviations are about proportional to the quantity of gas. The author concludes that with this indicator the proportion of fire-damp in a mine may be determined at any instant, and that it will even be possible to establish fire-damp observing stations, and thus contribute greatly to the scientific study of the subject.

Currents in the Earth—Dr. Foerster, director of the Berlin Observatory, has read a very interesting paper before the Elektrotechnische Verein accentuating the difficulty with which the problems of rival currents and their connection with the magnetism of the earth are beset. By this paper the way has been paved for further work, and it is now known that much which was conjecture rests on a sound basis. At the instigation of Werner Siemens a commission was named by the Verein in 1881. Dr. Foerster has acted as secretary of this commission, which Dr. Neumeyer, the director of Seewarte, soon joined. Systematic observations were conducted in the years from 1882 to 1890, with the assistance of the telegraph department. The chief observations of earth currents concern the underground telegraph cable lines Berlin-Dresden, 106 miles in an approximately north-south direction, and Berlin-Thorn, 218 miles west-east, and 924 days were finally selected for analysis. That meant that more than 22,000 hourly records had to be measured with the aid of micrometers, and the data compared with the corresponding records of the magnetic observatories of Wilhelmshaven, Vienna, several polar stations, etc. An immense amount of calculations had to be gone through before the real comparison could commence, and many magnetic tables did not become available till years after their period. The octavo volume now out confirms the preliminary account which Weinstein submitted to the Berlin Academy in 1886. The large and sudden variations in the earth currents coincide so completely with the variations in the magnetic declination and the horizontal intensity, that the difference in longitude between Berlin and Wilhelmshaven could be fixed within a second by earth current observations at the former spot, and the magnetic records of the Wilhelmshaven observatories. These comparisons, however, and the apparent lag or lead of the one phenomenon with regard to the other, do not admit of any conclusion as to which is the primary and which the secondary phenomenon. Yet for the strong and sudden variations it may be assumed that the earth currents are the primary feature. As regards the more regular, more gradual and less intense diurnal variations, the case is not so clear, although the diurnal maximum of the vertical magnetic intensity very nearly coincides with the maximum of the daily earth-current variations. It may be that the earth currents are induced by the variations in the earth magnetism. Giese came to that conclusion from his observations at Kingua-Fjord station with his isolated closed cable circuit, which showed the induction effects to be dependent upon the rate of change in the vertical magnetic intensity, as theory, indeed, demands. But Weinstein has proved that these maximum rates of changes in the magnetic intensity are not simultaneous with the maximum intensity of earth currents. The connection between earth currents and the horizontal magnetic components is certainly not simple. Weinstein has, however, pointed out that for such considerations, we have to study not only the intensity and direction of the earth currents, but also their planes. That plane may be vertical or horizontal or inclined. One would fancy that its position should be fairly constant. But the established influence of ultra-violet radiations on the electric conductivity of the air, the atmospheric potential, and the formation of clouds, in addition to the observations of comets and polar lights, suggest that there are atmospheric electric currents incessantly at play as there are earth currents. The polar lights are probably due to atmospheric electric currents between the upper layers of the air and earth, and these currents are visible only in the higher rarefied strata. Such currents would have their definite, but variable, planes with regard to the earth magnet. The problems can be attacked only by international cooperation, and for that Dr. Foerster pleads once more.

A railroad company in Pennsylvania prevented the striking miners in its coal mines from interfering with non-union workmen, who were employed in pumping water out of the mines, by building a barbed wire fence seven feet high about the pump-house and dynamo plant and then charging it heavily with electricity.

Selected Chapters in Electrochemistry.

By Harry C. Jones.

CHAPTER V—ON THE VELOCITY OF IONS.

WE HAVE referred repeatedly in our last chapter to the movements of the ions during electrolysis; the cations moving with the current toward the cathode, the anions against the current toward the anode. Since, from the law of Faraday, electricity can pass through solutions of electrolytes in only one way, by the simultaneous movement toward, and separation of the ions at the electrodes, it is obvious that the study of the velocities with which the ions travel under given conditions, is a matter of considerable importance.

There are really two problems involved in determining the velocities of the ions: First, the determination of the relative velocities with which the ions move; and, second, the determination of the absolute velocities with which the ions move. If the relative velocities of all the ions have once been determined and the absolute velocity of any one ion is known, the absolute velocities of all the ions can be calculated at once. We shall take up first the determination of the relative velocities of ions.

It is not a simple matter to see at once how the ions can move with very different velocities toward the poles, and yet the same number or same equivalence of ions separate at the two poles. No cation can separate at the cathode until an anion separates at the anode, and for every ion which separates at one pole an ion carrying the opposite charge must separate at the other pole. It may, of course, happen that one of the ions is bivalent and the other univalent. In this case, for every bivalent ion which separates at one pole, two univalent ions will separate at the other. This is obvious from Faraday's law, which refers the whole conception of chemical valence to the number of charges carried by the ions.

In consideration of the confusion which usually arises from the contemplation of the above problem for the first time, and with a desire to simplify it, Ostwald proposed the following illustration of what takes place when a current is passed through a solution of an electrolyte, whose cations and anions move with different velocities. Given a homogeneous solution, which always contains the same number of cations and anions, and let us say that the velocity of the anion is *twice* as great as that of the cation. Let us represent the anions thus, ○, and let us represent the cations thus, ⊖. In such a solution we would have the following arrangement of the parts:

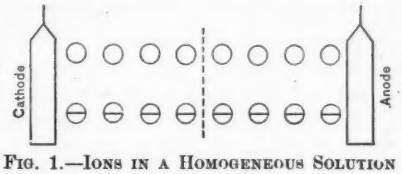


FIG. 1.—IONS IN A HOMOGENEOUS SOLUTION

For every anion there would be corresponding cation, and before the current was passed there would, of course, be no decomposition of the electrolyte. The perpendicular dotted line does not mean a partition running down through the solution, but is simply to indicate the middle of the solution.

Let a current be now passed through the solution, the anode and cathode being placed in the positions indicated in the above sketch. We can allow the current to pass until any number of molecules are decomposed; but for the sake of simplicity let the current flow until *three* molecules have been electrolyzed, and their ions caused to separate at the two poles. The following condition would then obtain in the solution:

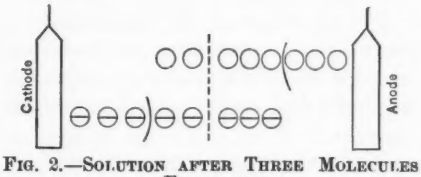


FIG. 2.—SOLUTION AFTER THREE MOLECULES ARE ELECTROLYZED.

We would have three anions separated at the anode, as shown by the three circles unpaired with cations; and we should, of course, have three cations separated at the cathode, as is shown by three lined circles unpaired with anions. The important part of the problem, however, from the standpoint of relative velocities of ions, still remains to be considered. Let us discard the anions and cations which have given up their charges, respectively, to the anode and cathode, and consider the condition of the solution which remains. It would be as shown in Fig. 3.

FIG. 3.—CONDITION OF REMAINING SOLUTION.

The same number of anions and cations are, of course, present in the solution, but their positions relative to the central plane running through the solution are very different from the positions occupied before the current was passed. In the original solution we had four anions and four cations on each side of the central plane. We have now only three anions and three cations on the right side of this plane, and only two anions and two cations on the left side of the plane. The conditions are thus markedly different; the original solution having lost one anion and one cation on the right side next to the anode, and two anions and two cations on the left side next to the cathode.

This illustration not only serves to show how the same number of anions and cations separate at the two poles, and yet the velocities of the two kinds of ions be very different, but also gives us the clue to the principle involved in determining the relative velocities of ions. It has been observed that on the anode side of the solution there is a loss of *one* molecule, and on the cathode side of the solution there is a loss of *two* molecules, the total number of molecules decomposed being *three*. The above numbers, one and two, bear exactly the same relation to one another as the velocities with which, by hypothesis, the cations and anions travel. We thus arrive at the general rule: To determine the relative velocity of the anion divide the change in concentration around the cathode by the total number of molecules decomposed. To determine the relative velocity of the cation divide the change in concentration around the anode by the total number of molecules decomposed.

So much by way of illustration of the principles involved. The more important question is how can these relative velocities be determined experimentally?

EXPERIMENTAL DETERMINATION OF THE RELATIVE VELOCITIES OF IONS.

It is obvious from what has been said, that in order to determine the relative velocities of any given cation and anion it is necessary to electrolyze a solution containing this cation and anion, and then to determine the changes in concentration around the elec-

trodes. The current should be passed until an appreciable change in concentration has been produced, but must be discontinued while there is still a middle layer of the solution unacted upon. We must know, in addition to the changes in concentration around the poles, the total amount of the electrolyte decomposed. This can be measured either directly, or, more conveniently, by simply measuring the amount of current which has passed through the electrolyte. If we know the amount of current which has passed, from Faraday's law we can calculate at once the amount of the electrolyte decomposed. In practice the mode of procedure is as follows: The solution is placed in some convenient form of apparatus (which will be described a little later) and the current passed until a considerable change in concentration has been produced around the electrodes; the electrodes used being of the same metal as the cation of the solution.

The solution, whose concentration was originally known, is now analyzed around both electrodes, and the change in concentration produced by the current thus determined. The amount of current which has passed through the solution is then determined by some convenient method, usually by means of a silver voltameter inserted into the circuit; and we have all the data necessary for calculating the relative velocities of the two ions.

A large number of forms of apparatus have been employed, the object being to secure a simple and satisfactory separation of the solutions around the two electrodes, after the electrolysis has been ended. It is not unfair to say that many of the forms which have been devised and used can not be regarded as having accomplished this end in a satisfactory manner.

One of the most satisfactory forms, as it appears to me, taking all sides of the problem into account, was devised and used by W. T. Mather in the Johns Hopkins University.* This apparatus consists essentially of two upright tubes, which should be closed at the bottom by stop-cocks. These are connected near the tops by a U tube, in the centre and at the lowest part of which a stop-cock of very large bore is inserted. The whole apparatus is thus perfectly symmetrical on the two sides. The electrodes were inserted into the bottom of the upright tubes, passing through ground-glass stoppers. It would be much better to have the bottoms of these tubes closed by stop-cocks, as stated above, and the electrodes pass into the tops of the tubes well down into the solutions on the two sides. The work in which this apparatus was used had to do with silver salts, consequently silver electrodes were used.

The current, measured by means of a silver voltameter, was passed until the solutions in the two upright tubes around the electrodes had suffered considerable change in concentration. The current was interrupted while there was still an unaltered layer filling the U tube, the stop-cock in this tube was closed, and then all the altered solution around each electrode was drawn off and analyzed. The change in concentration around each electrode was thus determined.

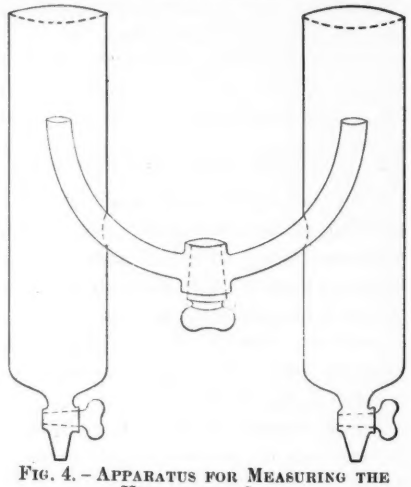


FIG. 4. – APPARATUS FOR MEASURING THE VELOCITY OF IONS.

The advantage of this apparatus over other forms, is that after the electrolysis is ended the two solutions can be readily separated and easily washed out of the vessel.

It is, in theory, not necessary to determine the changes in concentration around both electrodes, since the sum of these changes is always equal to the total amount of the electrolyte decomposed. It would be only necessary to determine the amount of current passed through the solution, which gives the total amount of the electrolyte decomposed, and the change in concentration around one electrode; the change in concentration around the other electrode being the difference between these two quantities.

In practice it is better to determine directly all the quantities and use the sum of the two as a check on the value of the third.

INFLUENCES WHICH MAY AFFECT THE RELATIVE VELOCITIES OF IONS.

It does not follow that the relative velocity of ions obtained under one set of conditions will hold under different conditions. The relative velocity might change with the strength of current used, with the strength of the solution, or possibly temperature would have an influence which would be different with different ions. These points can be decided only by direct experiment.

Let us take up first the effect of *changing the strength of current* used in electrolyzing the solution. It is self-evident that the actual velocities with which the ions travel would be greatly affected by the strength of current employed; the greater the current, the greater the velocity of the ions required to carry the current. Since the actual velocities would be so greatly changed, it is not improbable that the influence on the different ions would be different; in a word, that the relative velocities would be changed.

Currents of very different strengths were used by Hittorf, who studied this problem experimentally. He found that, for the strengths of current which he employed, the relative velocities are *independent* of the strength of the current.

It should be added that in all work on the relative velocities of ions very small currents must be employed, to avoid appreciable thermal changes, and in any wise mixing the solutions mechanically.

The next problem is *the effect of concentration of the solution* on the relative velocities. The more concentrated the solution the greater the viscosity, and, consequently, the greater the resistance offered to the movement of the ions through it. It seems probable that the movements of different ions would be affected differently, depending upon their size, mass, etc.

Hittorf has also experimented on this part of the problem, using solutions of copper sulphate ranging in concentration from one to twenty-four, and very different relative velocities were found for the copper ion. A few of his results with copper sulphate are as follows:

Parts Water to One Part Copper Sulphate.	Relative Velocity of Copper.
6.35	0.276
18.08	0.325
76.88	0.349
148.30	0.362

The velocity of copper as compared with the SO_4 ion is not constant, but increases with the dilution up to a certain point, beyond which it was found to remain constant no matter how much farther the dilution was increased.

The following are a few of the results which were obtained with silver nitrate:

Parts Water to One Part Silver Nitrate.	Velocity of the Silver Ion.
2.48	0.532
14.50	0.475
247.30	0.476

As the dilution of the solution increases

* A brief account of this method has already appeared in the Johns Hopkins University circular. The full account of the work will soon appear in the *American Chemical Journal.*

the velocity of the silver ion decreases up to a certain point, and then remains constant, no matter how much farther the dilution is carried.

In determining the relative velocities of ions it is, therefore, necessary to use very dilute solutions, and, indeed, solutions which are so dilute that when the dilution is increased still farther the relative velocities do not change. This point must be carefully observed in all work in which the relative velocities of ions are concerned.

The effect of *temperature* on the relative velocities of ions has also been made a matter of experiment. It is difficult to say just what result we should expect in this case. Perhaps, if temperature has any influence we would expect it to increase the difference between the velocities of the two ions, accelerating the faster ion at the expense of the slower. Hittorf, who worked on this problem over a considerable range of temperature, concluded that temperature has no effect on the relative velocities of the ions in copper sulphate.

Subsequent work, and especially that of Nernst on solutions of silver salts, has shown that his conclusion is erroneous. His results are extremely interesting, in that with *increase in temperature the velocities of all ions tend to become the same.*

Still more recent work by Bein, in Berlin, has shown that this conclusion is probably correct. A few of Bein's results are given below:

TEMPERATURES.

	20 Degrees.	90 Degrees.
Sodium chloride.....	0.608	0 551
Calcium "	0.602	0.549
Silver nitrate.....	0.470	0.490

The velocities given are those of the anions, and show that increase in temperature slows up the faster ion and accelerates the slower.

The meaning of this fact we do not know at present, but it is certainly very significant.

THE RESULTS FOR THE MORE COMMON IONS.

The relative velocities of some of the more common ions, expressed in the same units, as taken from the best measurements thus far made, are the following:

$\overset{+}{H}$	= 325	$\frac{1}{2}\overset{++}{Cd}$	= 55
$\overline{OH}$	= 170	$\frac{1}{2}\overset{++}{Ca}$	= 62
$\overset{+}{K}$	= 70.6	$\frac{1}{2}\overset{++}{Sr}$	= 63
$\overset{+}{Na}$	= 49.2	$\overline{Cl}$	= 70.2
$\overset{+}{Ag}$	= 59.1	$\overline{Br}$	= 73.0
$\frac{1}{2}\overset{++}{Cu}$	= 59.0	$\overline{I}$	= 72.0
$\frac{1}{2}\overset{++}{Zn}$	= 54.0	$\overline{NO_3}$	= 65.1

Hydrogen is much the swiftest of all the ions, having a velocity which is nearly twice that of the next swiftest ion —hydroxyl. Hydroxyl, in turn, has a velocity which is more than twice as great as the next faster ion; and, then, the velocities of the more common ions are of the magnitudes given in the table.

Our attention is naturally attracted in this connection especially to the two ions hydrogen and hydroxyl; these moving so much faster than any other known substances. A moment's thought and we see that these are the ions which, when combined, form water; and they are the ions formed when water dissociates. This recalls the *remarkable properties in general of the substance, water.* If we compare almost any property of water with the corresponding property of other substances, we shall find that it represents an extreme value. It either stands at the head or at the bottom of the list with respect to a given property, and usually at the head. Take the specific heat of liquids, water stands at the top. Take the dielectric constants or specific inductive capacities of liquids, water again stands at the top, with the possible exception of hydrogen dioxide, which, however, has not been proved. Take the power of liquids to dissolve other substances, water is by far the best solvent known. Take the power of solvents to ionize electrolytes, water is the strongest dissociant known; and so it goes through the long list of properties which can be compared. Taking all in all, the result of such a comparison would inevitably lead to the conclusion that *water is by far the most remarkable chemical compound known to man.*

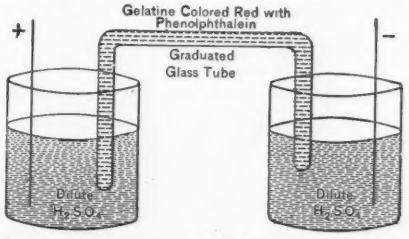


FIG. 5.—APPARATUS FOR DETERMINING ABSOLUTE VELOCITIES OF IONS.

The above is a slight digression from the main theme, but was suggested by the incomparably great velocities of the ions which unite and form water, and into which water dissociates, if only slightly, under ordinary conditions.

THE RELATIVE VELOCITIES OF ELEMENTARY IONS A PERIODIC FUNCTION OF THE ATOMIC WEIGHT.

We know to-day that a great number of the properties of the elements are periodic functions of the atomic weights of these elements. These relations have been generalized in the well-known "Periodic system" of the elements, which applies not only to the chemical but also to the physical properties of these elementary substances. Ostwald and Bredig have pointed out that this same periodicity manifests itself in the relative velocities of the ions. If these are plotted as ordinates against the atomic weights as abscissas, the halogens fall very near the maxima of the curve. The alkali metals occupy nearly the same position, while at the minima we find chromium and aluminum. Calcium and the other alkaline earths barium, strontium and magnesium occur at breaks on the descending arms of the curve, while cadmium and zinc occur near the minima.

While we have no idea as to the meaning of this recurrence of properties as the atomic weights increase, it is certainly of more than ordinary interest.

THE ABSOLUTE VELOCITIES OF IONS.

We have had to do thus far entirely with the relative velocities with which the ions move. This gives us, of course, no clue whatsoever as to the absolute distances which the ions travel in a given time under a given driving force.

Two general methods of determining the absolute velocities of ions have been worked out. Only one of these will be considered here. This involves a direct measurement of the distance traveled by a given ion in a given time, under a given potential gradient. The method in question was devised by the English physicist, Lodge, whose name it bears.

A graduated glass tube was bent at right angles near both ends, and filled with an aqueous solution of gelatine, to which some sodium chloride had been added. The contents of the tube were colored red by phenolphthaleïn, to which just enough sodium hydroxide had been added to bring out the red color. Both ends of this glass tube dip into vessels containing a dilute solution of sulphuric acid. Electrodes are inserted into these vessels, and a current passed from one to the other through the graduated glass tube. The hydrogen ions pass with the current into the graduated tube, displace the sodium ions from the sodium chloride, forming dydrochloric acid which decolorizes the phenolphthaleïn. The time is noted during which the current flows, the distance which the hydrogen ions travel is measured, and the drop in potential between the poles, which gives the potential gradient when the distance is known, is determined, and we have the data necessary for calculating the absolute velocities

with which the ions travel under the potential gradient in question.

The unit potential gradient is taken as a drop of a volt a centimetre, and for this gradient Lodge found the velocity of hydrogen, the swiftest of all ions, to be in round numbers three thousandths of a centimetre per second. In three determinations he obtained these values:

0.0028 cm. per second
0.0026 " " "
0.0024 " " "

Knowing the absolute velocity of one ion, and the relative velocities of all the more common ions, we can calculate at once the absolute velocities of all of these ions for unit potential gradient.

The above results for the velocity of hydrogen, the swiftest of all ions, can not but impress us by their small magnitude. Perhaps, however, we should not be surprised after all at these figures, when we consider the enormous resistance offered to the movements of the ions by the presence of the solvent, which always has considerable viscosity. The comparatively free movements of the gaseous molecules through space can not be compared with the movements of the ions through the resistent solvents, and yet we are tempted to try such comparisons, since the laws of gas-pressure apply to the osmotic pressure of solutions. It seems pretty clear that the cause of gas-pressure is to be found in the impacts of the rapidly moving gaseous particles against the walls of the confining vessel. It is difficult to furnish any similar explanation of osmotic pressure, especially when we consider how slowly the ions move through the solvent, even under a considerable driving force. That the molecules move with extreme slowness through the solvent is shown by the enormous amount of time required for diffusion to establish equilibrium in solutions, as became obvious when we were considering the principle of Soret. In the light of all these facts, and of the many unsuccessful attempts which have been made to explain osmotic pressure, it is only fair to say that we do not know what is the cause of osmotic pressure, but we do know very much about its results and their analogies to gas-pressure, the importance of which will appear before this series of papers is concluded.

A method for determining the absolute velocities of certain ions, based upon the same general principle as that of Lodge, was devised by Whetham in England. The method is so simple and yields such good results that it should be considered in this connection. The apparatus used consists of a longer perpendicular glass arm with a shorter arm attached obliquely to one side. One electrode is introduced into each arm. In order that this method should be applied it is necessary to have a common ion in combination with two other ions, the one colorless and the other colored. Thus, we must have chlorine in combination with copper; *i. e.*, a solution of copper chloride, and also chlorine in combination with some colorless ion like ammonium; *i. e.*, a solution of ammonium chloride. The denser solution (copper chloride) is poured into the longer arm of the apparatus until it rises a certain distance into the shorter arm, and the lighter solution (ammonium chloride) is carefully poured on to the top of the denser solution in the shorter arm. The current is now passed through the solutions from the ammonium to the copper chloride. The copper ions, like the ammonium, move with the current, and since they are colored and give the color to the solution of cupric chloride, the bounding layer between the two solutions, as it moves with the current, can be seen.

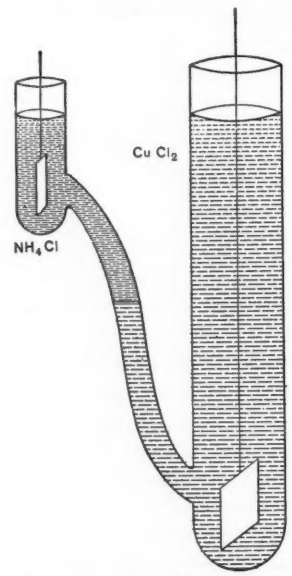


FIG. 6.—APPARATUS FOR WHETHAM'S METHOD OF DETERMINING VELOCITY OF IONS.

The time during which the current passed was noted, also the potential gradient of the current and the distance traveled by the bounding layer between the two solutions. From these data the absolute velocity of the copper ion in centimetres per second could be at once calculated.

This method is, of course, limited in its applicability to cases similar to the above, where the movement of the ion in question can be traced by means of changes in color.

In the last few years there have been a number of investigations* along the lines indicated in this paper, but the principles involved are essentially the same as those already considered. These investigations have had to do chiefly with improvements in the form of apparatus used, and in effecting better separations of the solutions after the electrolysis was completed. They will, therefore, not be further considered in this paper.

* These will all be cited in the paper which will soon appear, by Mather and Jones, in the *American Chemical Journal.*

THE NATURE OF THE IONS.

The method of electrolyzing solutions, which we have just been considering in connection with the determination of the relative velocity of ions, is also of value as enabling us to determine which constituents form cations and which anions. In the great majority of cases there is no difficulty encountered in answering this question. We know that all acids dissociate into a hydrogen cation, which gives them their characteristic property, and into an anion which comprises all the remainder of the molecule, and which, of course, varies with every acid. The general scheme of dissociation which is followed by acids is the following:

$$RH = \bar{R} + \overset{+}{H}.$$

Where $\bar{R}$ comprises all the molecule except the so-called replaceable hydrogen.

In the case of polybasic acids, the process is more complicated. Sulphuric acid breaks down first into $\overline{HSO_4}$ and $\overset{+}{H}$ and then, as the dilution is increased, the complex anion $\overline{HSO_4}$ breaks down into $\bar{\bar{SO}}_4$ and $\overset{+}{H}$.

The dissociation of bases is just as simple as that of acids, univalent bases dissociating according to the following scheme:

$$R'OH = \overset{+}{R'} + \overline{OH}.$$

The hydroxyl anion is the characteristic ion of all bases, and the remainder of the molecule forms the cation $\overset{+}{R'}$. Polyacid bases, like polybasic acids, may break down in stages, and in the cases of some of the weak bases almost certainly do so.

In connection with acids and bases it should be stated that some compounds dissociate under one set of conditions as an acid and under other conditions as a base. Thus, aluminum hydroxide in the presence of a strong acid dissociates as a base, forming a salt with the acid; while in the presence of a strong base it dissociates as an acid, forming a salt with the base.

The general scheme according to which salts of simple acids with simple bases dissociate is;

$$RR' = \bar{R} + \overset{+}{R'},$$

in which $\bar{R}$ is the anion of the acid and $\overset{+}{R'}$ the cation of the base. But either $\bar{R}$ or $\overset{+}{R'}$, or both, may be very complex, and in these cases it is often difficult to say just how the salt will dissociate. In such doubtful cases the method of electrolysis comes to our aid. Take the compound potassium platinic chloride, K_2PtCl_6; how will it dissociate in the presence of water? It is quite probable, indeed almost certain, that the more strongly positive potassium will exist in the cationic condition; but how about the platinum? will it also form cations or will it form a part of the anion? This can be answered by electrolyzing a solution of the compound, and then determining by analysis whether the platinum goes to the cathode or to the anode. It goes to the anode, forming a part of the anion, and the compound, therefore, dissociates as follows:

$$K_2PtCl_6 = \overset{+}{K} + \overset{+}{K} + \bar{PtCl_6}.$$

Take another case, potassium ferrocyanide $K_4Fe(CN)_6$; the potassium would obviously form cations, but what about the iron, would it also form cations, or would it, like the platinum in the above example, form part of the anion? The electrolysis of a solution of this salt in vessels like those already described in this chapter, in which the solutions can be readily separated after the electrolysis is ended, would answer the question. The iron has been found to go to the anode, and, therefore, forms part of the anion.

Other cases, considerably more complicated than the above, have been dealt with, in which the less positive metal went partly with the current to the cathode and partly against the current to the anode, showing that it partly dissociated as cation and partly as anion. The above examples, however, suffice to illustrate the manner in which electrolysis is made use of to determine how any given compound dissociates, and what is the nature of the cation and what that of the anion.

In the next chapter we shall study the passage of the current through solutions of electrolytes, or the conductivity of solutions.

Experiment has shown that an electric arc can be employed under water for fusing metal. The intense heat turns the water surrounding the arc into steam, thus forming an insulating cushion of vapor. It has been suggested that with proper apparatus the electric arc could be employed by divers for quickly cutting through large chain cables or iron plates under water.

ELECTRIC COPPER REFINING.

BY GEORGE E. WALSH.

The unprecedented production of copper in the United States during the past year, which has given to the American producers practical control of the copper markets of the world, has a closer relationship to the growth and development of the electrical industries than is supposed at first sight. Viewed from one standpoint, the marvelous ore yields of the Lake Superior copper mines directly caused the revolution in the copper trade, but had it not been for the rapid expansion of the electric industries, which to-day use a large percentage of the purest copper, the advanced prices would never have stimulated the working of the new copper regions.

The Lake Superior copper regions are to-day the richest and most valuable in the world, and they have produced enormous fortunes to their owners. The estimated market value of the lake copper products for 1900 is placed at $25,000,000. Great, however, as the product has been, the work of mining and marketing the copper has been fraught with much trouble and difficulty. Enormous capital is necessary for the opening and working of a copper mine. In the lake region, conservative capitalists place the amount necessary for this work at a quarter of a million dollars. There is probably no other mining field in the world where so much money and so great a length of time is required for the successful opening and working of a mine.

The demand for copper for electrical industries is not the only factor that has united copper mining and electrical development in a close relationship. Electricity has become necessary to the refining of copper. Electric copper refining has grown fully as phenomenally in this country in the past year as copper mining. When it is remembered that the first commercial refinery by the electrolytic process was erected in this country only 20 years ago, and that in 10 years thereafter there were only two such refineries in the United States, with a total output of only 24 tons of copper per day, an idea can be gained of the comparatively recent development of the industry. There are to-day fully two dozen electrolytic refineries, producing hundreds of thousands of tons of copper per year, besides several million ounces of silver and gold. Fully one-half and more of all the copper produced in the United States is refined by the electrolytic process, and about one-third of the world's whole output.

When the electrolytic process was first attempted the cost of producing the refined copper by this method was as high as $30 per ton, and even eight years ago the charge was $20. This has come down now to $8 and $10 per ton. This is the direct result of improving the refineries and of economizing in the electric power. Some of the improved copper refineries in the Lake Superior region are the finest in the world, and they have brought the cost of refining the copper to the lowest cost. The question of saving in the fuel and operating expenses has been the most important in the development of this industry, and the solution has been one of gradual growth and experiment. In the last year the saving has been further reduced through the introduction of improved machinery and an increase in the motive power.

Both the multiple and the series processes are employed in electrolytic copper refining in the lake copper regions, as well as in other parts of the country, and the relative importance of the two systems depends, in a measure, upon circumstances and topographical surroundings. The multiple system is the most generally used, and it is of greater relative value. The difference between the two systems is chiefly in the mode of arranging the electrodes. In the multiple system only one-half the anode copper is used as in the series system.

When the copper comes from the mines to the refinery it is in crude bars or cakes such as produced by ordinary smelting and concentration processes. They are tested first as to the quality and value of the copper in them, and also as to amount of gold and silver mixed with the crude ore. They are then heated in a reverberatory furnace, and prepared for the electrolytic bath in the form of anodes two and one-half feet in length and two feet three inches across. The anodes are carried from the furnace to depositing tanks to alternate with the cathodes of pure copper sheets. In each tank of the ordinary refinery there are about 20 to 25 anodes and 25 cathodes, separated from each other by about one and one-quarter inches.

In this multiple system the tanks are arranged in terraces, with each row separated by about two inches. A free circulation is kept up between the tanks, and an overflow pipe keeps the tanks properly filled, new fluid entering as fast as that drawn off. Electric traveling cranes usually supply the tanks with their material and carry the copper bars to the bath from the furnace. In the Anaconda re-

finery the electric traveling crane handles the copper from the time it enters the refinery until it is finished. In this refinery there are some 500 tanks arranged in rows or terraces, usually in pairs of double tanks.

The electrolyte prepared for the bath contains in solution 16 per cent of bluestone and 5 per cent of free sulphuric acid. The current enters the first tank through its anodes in multiple and proceeds through the bath to the adjacent cathodes, and from these it passes by copper connectors to the anodes of the second tank or bath. The copper connectors between the tanks are plates about six inches long, and they are carefully insulated from the negative conductor of the next bath. They connect the end of one anode in one tank with the cathode in the other.

The average electric current required for a refinery of 30 to 50 tons per day is about 10 amperes to the square foot, counting both sides of the anode plate, and the flow of this current varies considerable, according to the quality of the anode. The amount of precious metals, arsenic and other impurities in the copper anode decides to a great extent the flow of the electric current. Usually about 24 days and nights are necessary to transfer electrolytically the copper anode of about 275 pounds to the cathode plate. There is danger in employing a high current, for if the copper should have considerable silver and arsenic mixed with it the purity of the copper would be greatly lessened. The high current would carry part of the silver and arsenic to the copper to reduce its purity. Some copper is so pure and free from all impurities that as high as 15 and 20 amperes can be used without danger. Several of the tanks are always out of circuit, and are in the process of being cleaned.

After the copper has been refined it is further prepared for commercial purposes in other parts of the refinery. Some is melted in the reverberatory furnaces again and cast in bar molds. These are of suitable size for drawing into wire and rods for commercial purposes. The deposited sheets of pure copper are also sold just as they come from the bath under the name of commercial cathodes. Sometimes the rich copper is full of precious metals, carrying often as high as 500 and 600 ounces of gold or silver to the ton. All these metals and impurities are separated from the copper by the electrolytic process and deposited at the bottom of the tanks. They fall there in the form of a black mud. This mud or slime is carefully gathered up and screened. It is then boiled or stirred up in a lead-lined vat with hot dilute sulphuric acid. Hot air and steam are provided through a lead coil by means of an injector to help oxidize and dissolve the impurities of the mud. In this way the gold and silver are gradually concentrated in about eight to nine hours. There are usually, besides the gold and silver, such impurities as arsenic, antimony, bismuth, lead and tellurium.

There have been many improvements and changes in the last year or two in the copper refining methods. One of the most annoying features of the electrolysis is the action of the impurities on the cathodes. The arsenic, antimony and silver tend to collect on the cathodes, and, in time, make them unfit for use. In copper regions, where the ore runs high in silver, this difficulty is peculiarly hard to overcome, and it causes a considerable additional expense through the employment of laborers to wash the anodes. There have been a number of methods to overcome this trouble. The one commonly resorted to is to purify the electrolyte by filtration through a bed of copper oxide, and another by boiling with metastannic acid. Another method of purifying the electrolyte has been to cause oxidization with jets of air, but this process has not yet attained any great success. At the Anaconda refinery a process of purification is to pass the impure electrolyte repeatedly through a filter of oxidized granulated copper, and then later introduce jets of air.

Some inventors working upon the theory that much of the arsenic, silver and antimony are not precipitated electrolytically in the bath, but mechanically by suspended impurities settling on the rough surface of the cathode, have sought other ways of reaching the same ends by obtaining an exceedingly rapid clarification of the electrolyte.

In the series system of electric copper refining in this country, special cathodes are not used, but one side of the anode plate serves as cathode. In this process the fluid itself serves as the conductor of the current and no copper connections between the anodes are necessary. The copper plates are arranged in series, and the tanks are much larger than those used in the multiple system. The fact that a good deal of scrap copper is produced by this process of refining makes it unpopular, and only a few refineries are in existence in this country. This drawback is a serious one, and not easily remedied. The multiple process requires only one-half the anode copper used in the series system with the same cathode surface. The cost of maintaining a plant to the highest efficiency has been found to be greater in the series process than in the multiple, but the former saves somewhat in the less loss of energy. The location of the refinery is consequently a factor of some importance, for if fuel is cheap or the power is supplied by waterfall the series system has little to show in its favor in the cost of the electric current. The cost of erecting a refinery is nearly the same in each system, with a slight advantage in favor of the series process.

It is estimated on the whole by modern refiners that there is nearly a saving of $2 per ton of refined copper in the multiple system, and this difference in some localities and under favorable conditions can be even further extended. In some mining regions where the refinery is a part of a converting establishment, and run in conjunction with it, the saving has been as much as $3.50 per ton. This is partly due to the fact that the anodes can be made directly from the converters. The average current efficiency of the multiple process is 95 per cent as against 90 per cent for the series process under similar conditions. Where the electric power is expensive, or fuel high-priced, the difference in the current efficiency of the two processes must always decide in favor of the multiple process of refining copper.

French Submarine Boats.

The French submarine boats which are now rapidly approaching completion at Cherbourg are to have double motors, enabling them to proceed under steam or by electricity, like the Narval. They will not be submersibles, like the Narval, but true submarines, with something of an enlarged range of action, being, up to a certain point, autonomous, and having the power of plunging more rapidly than the submersible type. The Narval, in recent trials, covered 260 miles between Cherbourg and St. Malo in 40 hours, and 90 miles on the return, making in all 350 miles, of which she was towed 30 under water, and the accumulators were charged twice during surface steaming. On arriving at Cherbourg the petroleum was not exhausted, and firing the torpedoes showed that the tubes had received no damage. Owing to complaints of the exhausting effects of submersion on the crew a trial has lately been made, Dr. Gibrat, a medical officer of the French Navy, being in the boat. It is said to have been proved conclusively that the strain was far too much for the men. The close confinement and the want of fresh air produced nausea and exhaustion, and the men are said to have been completely unnerved. Otherwise the boat has given satisfactory results.

A Typical New York Telephone Central Office.

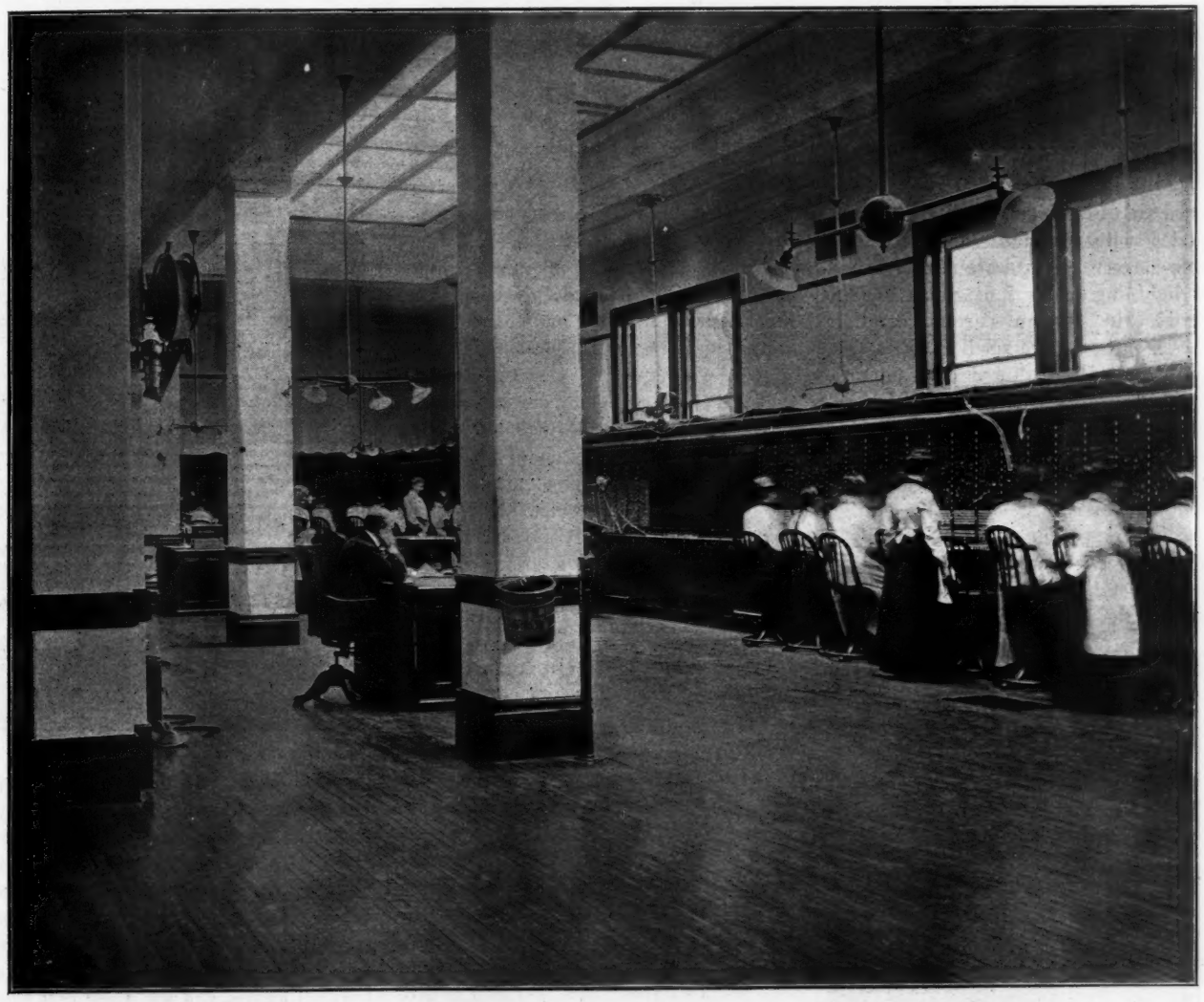
The Eighteenth Street Central Office of the New York Telephone Company—A Complete Model Installation on the Common Battery System.

FOR two or three years past the New York Telephone Company, which operates all of the telephones in the boroughs of Manhattan and the Bronx, in New York city, has been changing over its central offices from the distributed battery system to the Carty common battery method of operation. Of its new central offices built upon this more modern system perhaps that situated at Eighteenth street and Irving place, in New York city, is the finest.

The station is one of sixteen in the two boroughs, and has recently been completed with its new installation of switchboard and auxiliaries. The company erected at the site named above a six-story building of white brick and stone and occupies the entire building for telephone purposes, with the exception of a portion of the ground floor which is to be rented for stores or offices. The arrangement of the central office is such that executive and business offices occupy the second and third floors; the fourth floor is given over to the generating equipment and the cross-connecting boards; the fifth floor is utilized wholly for the operators' quarters consisting of locker rooms, infirmary, reading-rooms and dining-rooms for employés, while the whole of the sixth floor is devoted to the great operating room in which is located the switchboard shown in the accompanying illustrations.

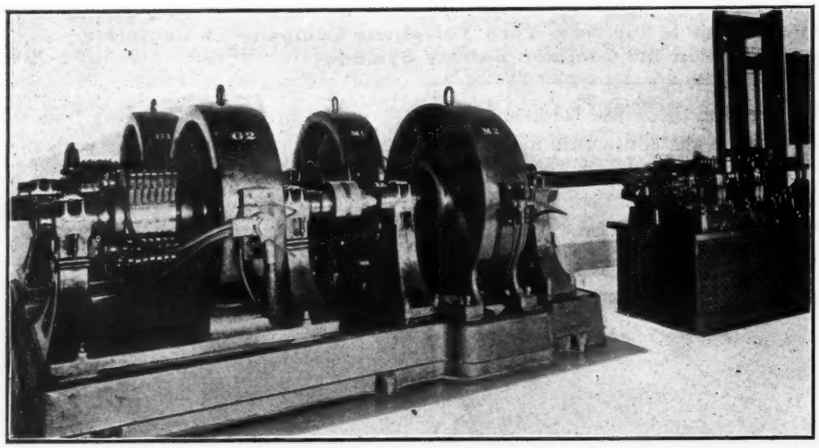
Cables bringing in entering lines come up through ducts laid in the walls of the building, and so arranged that the cables come directly to the fourth floor, where they are "fanned out" to the terminals on the distributing or cross-connecting board. By this construction the underground cable system actually terminates on the fourth floor of the building behind the distributing board, where all of the terminals are easy of access and any cable can be pulled out to a near-by manhole without disturbing in any way the occupants of the intermediate floors of the building.

The entering cables are of the paper-insulated variety, lead-covered, the termi-



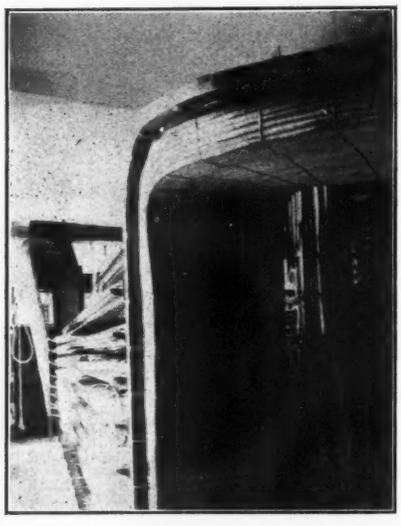
A Corner in the Operating Room of the Eighteenth Street Central Telephone Office, New York.

nals being of the ordinary pot-head variety, and all of the wiring from these terminals to the final ends of the circuits in the multiple jacks on the main switch-



The Generating Plant in the Eighteenth Street Central Office.

board are of combined silk and cotton insulated wire laid into cables. On the cross-connecting board are mounted, first, the lightning arresters, or, rather, for this service, the foreign current arresters. These consist of two small blocks of carbon separated by a thin sheet of mica cut in the form of the letter U and of such thickness that the carbon blocks are separated a distance sufficient to permit any current in excess of 350 volts to jump over from one block to the other. In addition to this arrangement one of each pair of blocks is recessed and contains a plug of fusible metal. In case of an arc forming between the blocks this melts and effec-



Cables from the Distributing Board.

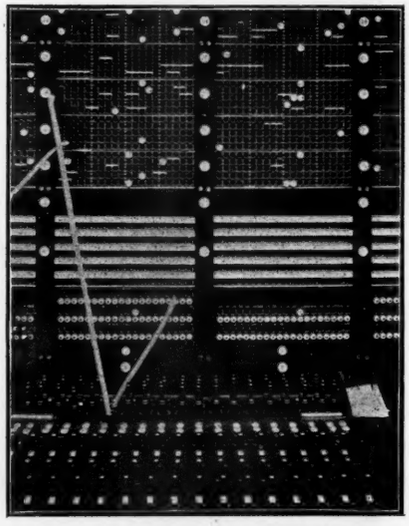
tually short-circuits them and grounds the line.

Passing from the cross-connecting board circuits enter the rack of relays used in connection with the common battery system, and pass thence in cables to the rear of the operating switchboard on the upper floor.

The equipment of this central office for battery charging and for the maintenance of its supply of current is exceedingly elaborate. All of its parts are in duplicate, and the most ample provisions have been made to minimize any change of interruption of service on account of stoppage of the supply of current from the street mains or any other cause. The 220-volt current entering from the street operates two 15-kilowatt motor-generators, which give 25 volts direct current in the secondary. From this current, which is controlled on an elaborate switchboard shown in one of the illustrations, the battery consisting of 11 chloride cells of large size is fed, and from this battery all of the service of the exchange, both for talking and operating the signal lights of the switchboard, is fed. Near the motor-generators for this service are mounted duplicate sets of ringing apparatus and apparatus for giving the busy signal over the trunk line. The ringing apparatus consists of motor-generators operated on the direct-current side from the storage battery and give out alternating current at the proper frequency for ringing subscribers' bells when the latter are called. The busy signal for trunk lines consists of a current of a character to give a buzzing sound in the ear of the operator who calls for a line that is already connected. These machines are of the Western Electric type and are so well shown in one of the accompanying illustrations as scarcely to require further description.

The main operating room is of large dimensions and the switchboard is built around it on four sides, with a break in the middle of one side for the entrance doors. This board is one of the most elaborate and complete in its construction in existence. It is of the full multiple variety, with a capacity for 7,000 lines, and has connected at present 5,600 subscribers. One portion of the board is used for trunking calls from other central offices of the company and for long-distance lines. The illustrations give a good idea of the general appearance of the board and of its detail, and show also the ingenious key mechanism used by the operators in performing their functions.

An incoming call is announced to the operator at whose section it comes in by the lighting of a small incandescent lamp placed near one of the answering jacks. Plugging into this the operator receives the desired number from the calling subscriber, and should this be one belonging to the same exchange, she has within reach multiple jacks connected with all of the 7,000 entering lines. With the other end of the cord she tests the line desired, and if it is not busy she can at once make



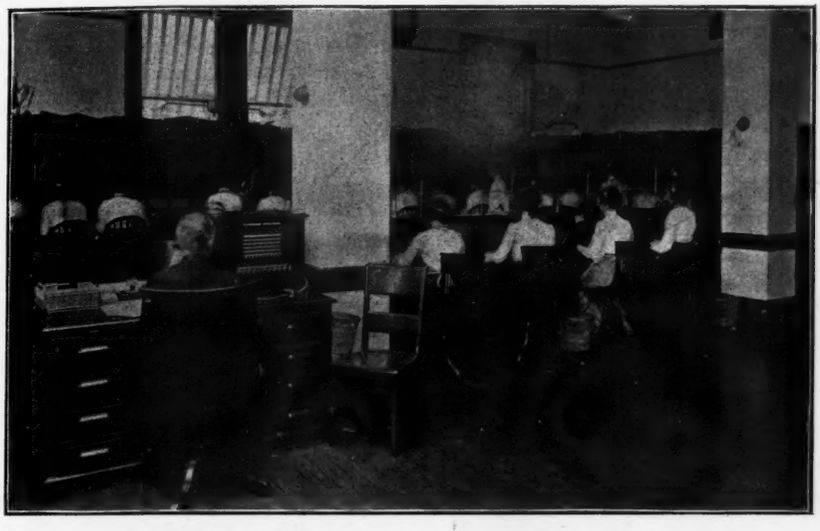
A Detail of the Main Switchboard.

the connection. If the line is busy the fact is made known to the operator by a click in her telephone when she tests. Pressing a key on the level part of the switchboard rings the called subscriber. Whenever either of the two subscribers talking hangs up his telephone one light in the cord circuit on the level part of the board is lighted and the disconnect signal is given to the operator by the lighting of the two lamps, which are close together in the cord circuit. Should the call come in for connection with a station belonging to one of the other central offices of the company, it is made through one of the outgoing trunk lines, which are also in reach of the operators.

In calls incoming from other central offices, automatic ringing of the subscribers is used. The ringing signal is controlled by a push-button, which, after be-

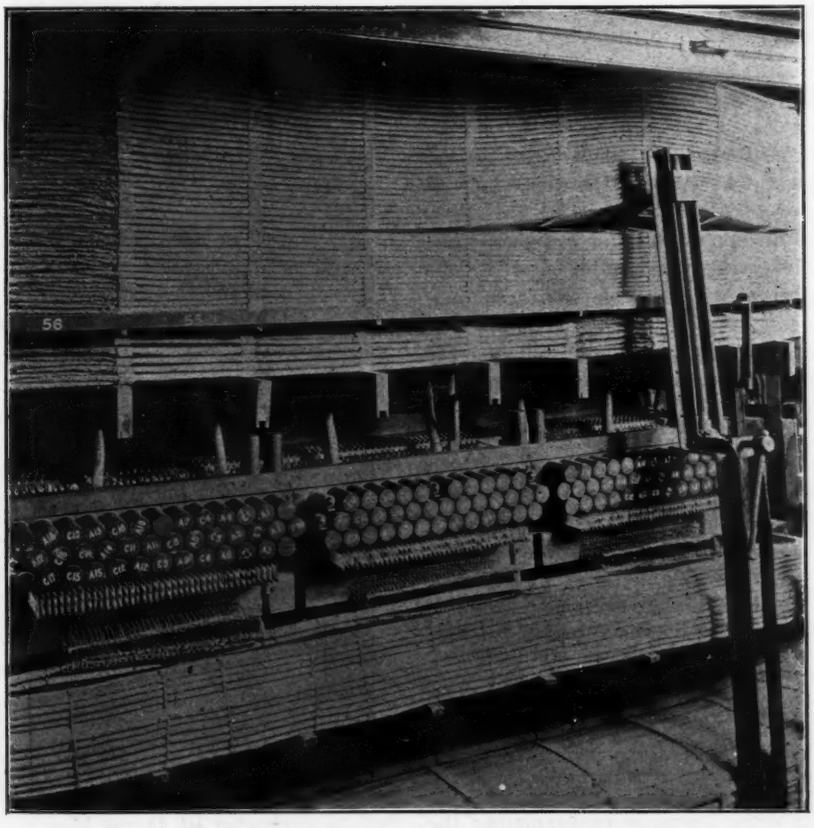
ing depressed, is locked and rings the subscriber called at intervals until he answers, when the ringing current is cut off automatically.

In the middle of the room is situated the desk, or switchboard, for the monitors, with arrangements for communication between these and any of the operators of the switchboard. An ingenious system, whereby the number of monitors on duty can be increased or diminished as the load rises and falls during the day, is used on this board. Each monitor has 20 switchboard lines, and each is provided with a bank of 20 jacks and their corresponding signal lamps. The middle operator's position is furnished with 80 of these, the two on each side of this position with 40 each, and the positions at the end with only 20. With all of the monitors at work each normally has care of 20 of these circuits. When the load slackens, the end operators retire, and by throwing a switch distribute their circuits among the three in the middle. Late at night two of these retire and leave only one operator in charge of all the positions, this being quite sufficient for the number of calls coming in at that hour. The monitor takes care of all special calls, such as inquiry and appointment calls and information for subscribers.



THE MONITORS' DESKS, EIGHTEENTH STREET CENTRAL OFFICE.

The back of the main switchboard is of interest particularly on account of the elaborate cabling system in use. The number of connections and wires required to maintain a full multiple service of 7,000 lines runs into figures that have practically no meaning. The result is a vast bulk of cables behind the switchboard, and these are so well shown in the illustration as to make description unnecessary. One of the numerous ingenious devices employed about the installation is that by which these cables are handled and access is had from the back of the board to any one of them, in case repairs or alterations are necessary. This is shown in detail in an illustration. The mass of cables is so heavy that it would be impossible to lift them by hand, and the use of wedges driven between them is not considered advisable; in consequence, the apparatus shown is in use, this consisting of a combination steel wedge and jack screw enabling the quick and easy lifting of any number of cables and the exposure of any one required.

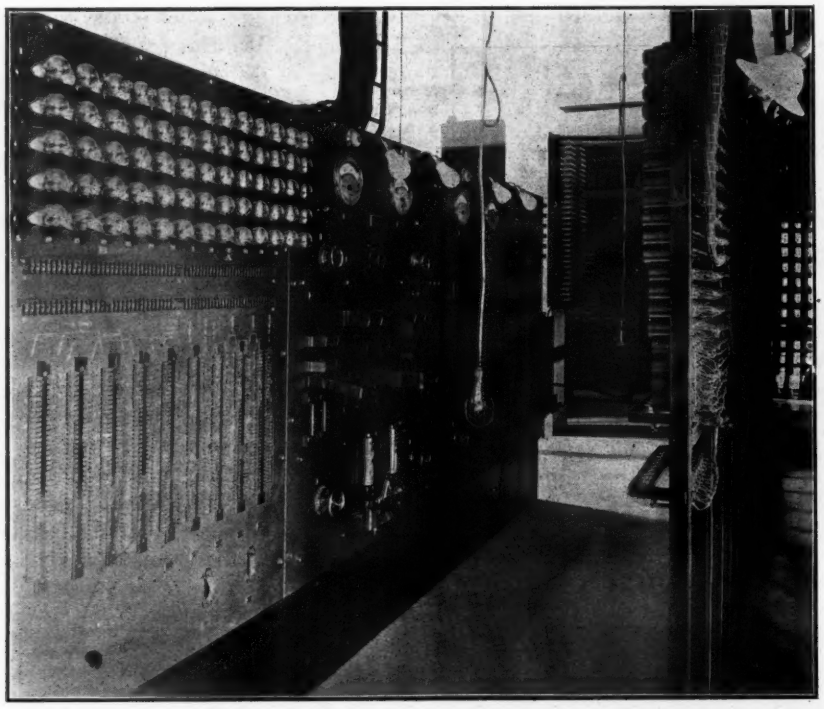


BACK OF THE SWITCHBOARD, SHOWING APPLIANCES FOR LIFTING CABLES.

One of the most interesting features of the Eighteenth street station is the highly elaborate provision made by the company for the care and comfort of its operators. The whole of the fifth floor is given over to the use of the young women employés, the photographs giving an excellent idea of the rooms which are there provided for them. The cloak room contains wire lockers, two operators sharing each, and being provided with private keys. In this their wraps, hats, etc., are deposited when they enter the building. Adjacent to this room is the restaurant, or lunch room, in which are tables and chairs, and in which also a service of cooks and waiters is maintained. Tea, coffee and milk are furnished free by the company, and messengers are provided who may be sent out to near-by restaurants or shops to buy anything required by the operators. Arrangements are also made to heat the lunches they bring with them and to supply hot water.

On the Irving place front of the building, opening out from this refectory, is a large reading-room furnished with all of the periodicals of interest to women, and provided with comfortable easy-chairs and rocking-chairs. Here their rest hours

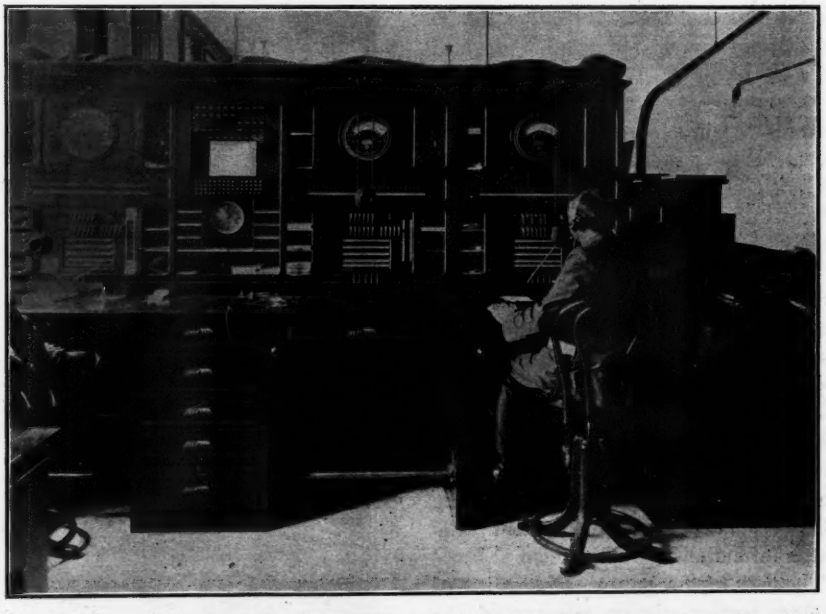
are spent under the most pleasant surroundings. Next to this room is one called, for the want of a better name, the "Infirmary," containing couches, easy-chairs and a chest of ordinary restoratives and medicines, the whole being in the charge of a matron. Here operators attacked by illness or overcome by fatigue have an opportunity for recuperation.



THE POWER SWITCHBOARD IN THE EIGHTEENTH STREET CENTRAL OFFICE.

The energy necessary for operating this central office varies from 200 to 300 amperes at 24 volts from the battery. Perhaps in no other similar installation has the whole total of telephone service been worked out with such elaborate perfection, nor the wants of both the public and the personnel of the company's service been studied with greater care and attention.

This telephone central office was visited by the members of the American Institute of Electrical Engineers on Thursday of last week. It attracted much favorable comment from the many electrical engineers present from abroad, and proved of great interest to all the visitors, who were shown every detail of the modern exchange by the courteous representatives of the telephone company.



THE WIRE CHIEF'S DESK AND TESTING BOARD, EIGHTEENTH STREET CENTRAL OFFICE.

A group of engineers of Lyons and the neighboring towns is contemplating the putting down of a hydro-electric plant at Bellegarde-on-the-Rhone capable of supplying 100,000 horse-power at low water. Part of this power would be transmitted to Lyons through aerial cables; a branch would also supply the industrial region of Belley, Aoste, La Tour-du-Pin and Bourgoin, with cheap electric power from the main station in question.

Association of Edison Illuminating Companies.

The annual convention of the Association of Edison Illuminating Companies, Mr. J. W. Lieb, president, and Mr. Wilson S. Howell, secretary, will be held in Buffalo, September 10, 11 and 12.

The headquarters of the association will be at the Niagara Hotel, and the sessions of the convention will be held in the New York State Building, on the Pan-American Exposition grounds. A large attendance of the interests represented by this association is expected. The full programme will be announced later.

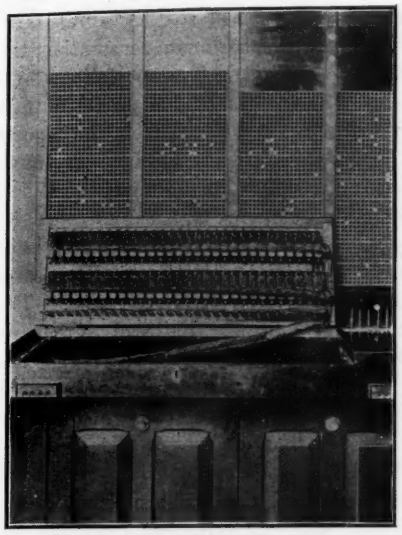
Economy of Copper in Transmission Lines.

A short summary of a paper on this subject by Mr. Latour appeared in *Science Abstracts* for July. In this paper he points out that the use of accumulators at the distant end of a line may conduce to economy in the cost of a transmission line in cases where the power is transmitted over comparatively short distances. This is due to the possibility of sending along the transmission line a constant current which is equivalent to the mean amount of current required throughout the day, or, in other words, to the possibility of maintaining a constant load on the running machinery. He shows that if, under the usual conditions, full load is maintained on the line during eight hours of the day, and there is no load during the remaining 16 hours, the loss in the transmission line is three times as great as it would be if, with the use of accumulators, it were possible to maintain a steady load on the line equal to the mean load required. It is pointed out that this requires to be somewhat corrected to allow for the fact that the efficiency of the battery is not 100 per cent; but even allowing for this, the line loss would be much smaller in the one case than in the other. The matter may be put in another way; it is possible to have much less copper in the line in the one case than in the other, and yet have equal daily loss in the line; and, consequently, from the point of view of the author, the use of accumulators may be said to conduce to economy in the cost of copper. No estimate is, however, made of the cost of plant under the two conditions, though it is pointed out that the use of accumulators dispenses with the cost of transformers at the distributing station.

Extension of Telegraph in Alaska.

The military authorities in Alaska report to the War Department that there will be a great extension of the telegraphic service in that territory during the present season. Captain William R. Abercrombie is engaged with a large force of men in constructing the proposed military route from Valdes, on the southern coast, to Circle City, on the upper Yukon, near the boundary of the British Northwest Territory. At the same time the military telegraph line is being extended along that route, and it is expected that even before the completion of the wagon road the telegraph facilities over the entire distance, from the Gulf of Alaska to the Yukon, will be in operation. While this work is going on, large detachments of army signal corps men are extending the telegraph along the Yukon, so that the means of communication between all the military posts in Alaska from east to west may be complete before winter sets in.

The work has progressed so far now that there is immediate need of operators for the various stations, and the War Department has sent 30 non-commissioned officers and enlisted men of the signal corps to report immediately to Lieutenant William Mitchell, at Seattle, Wash., whence they will join an expedition to sail for Alaska. The signal corps is now engaged in laying the military ocean cable from Skagway to Juneau, the new territory capital. When the various projects now in progress are complete, which will be some time during the coming fall, it will be possible to telegraph from the United States, by way of Canada, to any important place or military post in Alaska, summer or winter. Even the far northern mining camps of Nome and Teller will not be cut off from the world during the winter months, as heretofore.



DETAIL OF MAIN SWITCHBOARD SHOWING CALLING AND RINGING KEYS.

THE OPERATORS' READING ROOM. EIGHTEENTH STREET TELEPHONE CENTRAL OFFICE.

A VIEW IN THE OPERATORS' REFECTORY.

Electrolytic Filters.

Frederick W. Lemp and William Koedding, of St. Louis, Mo., have received a patent for an electrolytic water purifier in which there are electrodes of iron, in the form of a series of vertical, closely spaced plates, of which the end members only are connected with the source of current, the intermediate plates functioning as bipolar electrodes. The water to be purified passes upward between these plates from a distributor, and thence, under pressure, to a settling tank, which it enters tangentially, whereby is imparted to it a swift rotary movement that carries the bulk of the suspended impurities to the periphery. The purer water is withdrawn axially from the tank, passes upward through a filtering bed, still under pressure, to an ingeniously constructed valve in the discharge pipe.

Electric Traction Stocks as Reliable Investments.

["G. T. C." *in New York Sun.*]

Now that the investing public, and, to an extent, the speculative community, are beginning to regain confidence, it seems worth while to direct attention to a class of properties which could not, in any event, be materially affected by a reduction in the corn crop or in the yield of any other staple product, nor by the industrial disturbances which have afflicted various localities. It is a singular fact that in spite of the extraordinary development in the facilities of rapid transit throughout the United States in the last decade the securities based upon local enterprises of the character described have not yet obtained a general market. The most natural explanation of this circumstance is that the enterprises are largely local and the market for their securities is consequently circumscribed. Those securities are, to an extent, analogous to municipal bonds, the dealings in which are almost entirely over the counter, and which pass from municipalities to investors through the hands of bankers and dealers, who make a specialty of buying and placing such obligations.

In the New York market the dealings in traction securities are virtually limited to three stocks, and in Boston, Chicago and Philadelphia to the shares of companies operating in those cities or the sections contiguous to them. The volume of securities based upon traction enterprises would seem to be large enough to warrant a more general and broader market for them than exists. With the development of electricity as a propelling power in the last decade there have been constructed in the United States over 20,000 miles of road operated by electric current. The par value of the securities based upon these lines is in excess of $2,000,000,000. That the bonds issued by the companies operating local rapid transit systems are regarded as a safe and desirable investment is indicated by the large amounts of them held by savings banks, trust companies and insurance companies, as shown by the reports of these institutions to various state departments, with which they must file statements of their assets and operations.

Although the development of local transit facilities may be regarded as still in its infancy, since the transition from antiquated horse-car lines to electric equipment began only 12 years ago, sufficient data have been compiled to determine the safety, the permanency and probable improvement in the value of securities based upon rapid-transit facilities that are not over-capitalized. In the larger cities the traffic increases steadily to the extent of six to ten per cent per annum. This is due in part to the increase in population and also to the unconscious necessity on the part of the public to minimize the time spent in travel. In addition, the system of transfers resulting from the consolidation of local lines stimulates traffic to a most remarkable degree. This is shown most plainly in the reports of the Metropolitan Street Railway Company, of this city. Every important line taken over by that company shows more than double the earnings that were made by those lines when operated separately; yet not only does the public enjoy a better service than ever before, both in respect to time and the distance that can be traveled for a single fare, but it travels more economically. Last year the Metropolitan company issued approximately 179,000,000 transfers, which represent a saving in fares to the public of over $8,000,000. At the same time the company increased its earnings owing to the larger volume of traffic stimulated by its time-saving and cash-saving service.

Suburban trolley lines, as they are popularly called, create traffic. It was the knowledge of this fact, which he had demonstrated to his own satisfaction, that influenced the late Mr. Al Johnson in his plans for gridironing the eastern portion of Pennsylvania with a system of rapid-transit electric roads. The pliability, so to speak, of electric railway construction, which ignores grades, curves and expensive road-beds, makes it possible literally to run cars to the doors of homes in thousands of villages and to those of farmers living between the smaller centres of population. It is somewhat of an effort for the average dweller in the country to drive a mile or more to the railway station, or even to walk a fraction of a mile and then pay 25 cents or more to travel to the desired destination; but it soon becomes a habit to jump upon a trolley car and reach the same point at an expenditure of five or ten cents. All this would not be possible if experience had not demonstrated that passengers can be carried at an expense far below the cost of transporting them on roads operated by steam motive power. It is this demonstration that has induced the Manhattan Railway Company to adopt plans for discarding its present equipment for electric facilities at a cost of many millions of dollars.

A branch of the electric transportation industry that is just beginning to be developed and which bids fair to be as important and as profitable as passenger traffic is the handling of freight. In several of the smaller cities and on many of the suburban lines this business has already been taken up, and within the last few weeks the Metropolitan Street Railway Company has started an express service through a subordinate corporation, the New York Electric Transportation Company. Some idea of the profits of this system may be obtained from the reports of companies already engaged in transporting freight. For example, the Union Traction Company, of Albany, reports its gross receipts per car-mile from freight at 58⅞ cents and the operating expenses as a little more than 12 cents. The Newburgh Street Railroad Company makes even a better showing. The gross receipts per car-mile are 61½ cents and the operating expenses a little less than 13 cents. The Brooklyn Rapid Transit Company, however, does not make so good a showing, presumably because a sufficient volume of traffic has not yet been developed. The operating expenses on that system are about the same as on the others, being a little over 13 cents per car-mile and only a fraction less than the gross receipts.

The statistics of electric railway operations, to which only the briefest mention has been made, are replete with interest to students of transportation problems and pregnant with suggestions as to the future of the entire carrying business. As yet the construction of electric railways outside of cities has not perceptibly encroached upon the earnings of steam railways, but it would seem to be only a question of time when the cheapness, and, in many respects, the superior facilities of these roads will receive serious attention from the managers of the long-distance lines. In view of the progress of electrical science in the last few years expectations that the steam railways will be transformed into cheaper, more comfortable and more rapid means of transportation than at present may not be regarded as a chimerical dream.

The French Association of Electrical Engineers has lately decided that every year a portion of the funds in hand shall be set apart toward subsidizing the scientific researches carried out by any of the members. Those members who wish to investigate technical questions, and who are desirous of availing themselves of the facility afforded by the clause, place their request before the committee; the latter in their turn ask each member's opinion as to the advisability of the investigation. The association is kept duly informed of the progress made in the researches and experiments.

The American Institute of Electrical Engineers' Annual Meeting.

The Annual Convention of the Institute—Meetings in New York, and Excursions to Points of Interest—Trip up the Hudson River—Visit to Schenectady—Sessions at Buffalo—The Pan-American Exposition.

THE annual meeting of the American Institute of Electrical Engineers for 1901 was begun under pleasant auspices, in New York city, on August 14. At noon the meeting was called to order by President C. P. Steinmetz in the meeting rooms of the American Society of Mechanical Engineers, and a short address of welcome was made.

Mr. Steinmetz spoke of the pleasure which all the members of the Institute enjoyed at seeing present a number of delegates from the sister society in France. He enlarged upon the fact that science is not sectional and knows no nationality, and that, like science, engineering welcomes the work of all people. The occasion, he said, was one for general congratulation, and it was pleasant to have an opportunity to reciprocate the many attentions that were showered upon the Institute at its meeting in Paris last year by members of the Société Internationale des Electriciens. At the conclusion of his remarks, President Steinmetz requested Mr. C. O. Mailloux, of New York, to make some further remarks of welcome to the visiting guests.

Mr. Mailloux made a brief and graceful address, in French, in which he further emphasized the feeling of engineers and scientific men that science and human advance in general were not confined by national boundary lines. He spoke of the growing feeling of international fraternity among electrical engineers, and extended in the name of the Institute a general welcome to the visiting strangers.

M. P. Janet, the head of the delegation from the Société Internationale, responded on behalf of himself and his colleagues, and in thanking the Institute for the welcome extended them took occasion to point out the community of interest which exists among electricians wherever they are found. M. Janet is a graceful and fluent speaker, and his remarks were greeted with much applause.

After the reading of some formal announcements concerning the programme for the next few days, a formal adjournment was taken until Tuesday, August 20, when the Institute meetings proper will continue at Buffalo. In the meantime a programme of entertainments and of visits to various points of interest has been arranged, these being described in their due order below.

A luncheon was then served in the basement, a very attractive menu having been prepared by the indefatigable committee on arrangements, consisting of Messrs. C. O. Mailloux and E. H. Mullin. During the course of the luncheon, at the urgent call of the members present, President Steinmetz made a lengthy and humorous speech, in which he described with great detail his numerous residences and the reason why he lived in four places at once.

The foreign guests and visitors were:

M. Paul Janet, director of the Laboratoire Central and the Ecole Polytechnique, Paris.

MR. CHARLES P. STEINMETZ, PRESIDENT OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

M. Henri Boy de la Tour, chief engineer of the Fives-Lille Company, Lyons, France.

M. B. Roux, civil engineer.

M. Paul Debeauve, superintendent of the Maison Breguet, Paris.

MM. Charles David and J. Courbier, Laboratoire Central and the Ecole Superieur de l'Electricite, Paris.

MM. A. Maurice Aubert and J. Marcel Aubert, electrical engineers.

All of these gentlemen are members of the Société Internationale des Electriciens, of which M. Janet is the official delegate.

Professor Gustave Gillon, of the University of Louvain, Belgium.

Herr F. W. Ch. Janisch, chief engineer of the Siemens & Halske Company, Berlin.

Mr. D. McNaught and Mr. Norman C. Sawers, Silvertown, England.

Mr. Arthur H. Pott, London.

THURSDAY, AUGUST 15.

The members assembled at 9.20 A. M. at the ferries connecting with the Lackawanna Railroad, where the party were met by Professor Francis B. Crocker and several gentlemen connected with the Crocker-Wheeler Company. A special train had been provided, and in this the party went out to Ampere, N. J., where they were received at the Crocker-Wheeler works by Dr. Schuyler S. Wheeler, the president of the company, and a number of his associates and assistants. The party spent two hours very pleasantly in visiting the various departments of the works and in witnessing all the numerous varieties of electrical activity which were in evidence. These works are at present very busy and the visitors were given an opportunity to see practically every variety of work done in them. Of especial interest was the elaborate and comprehensive system of stock-keeping and storage parts for assembly. This was examined in great detail by many of the foreign visitors and proved highly interesting.

Returning by a special train to New York, the party went to the Everett House, where luncheon was served. The committee in charge of entertainment again showed its good sense in arranging for a sort of *al fresco* lunch, which was particularly enjoyable and delightful.

The next visit was to the exchange of the New York Telephone Company, situated at Eighteenth street and Irving place. The superb central office is fully described and illustrated on other pages of this number of the ELECTRICAL REVIEW. The party was escorted through the building by several of the officers and employés of the company, and much interest was exhibited by all the visitors.

In the afternoon the foreign guests visited the offices of the ELECTRICAL REVIEW in the Park Row Building, the highest and largest office-building in the world, and inspected the building.

They were shown, through the courtesy of Mr. E. P. Bryan, general manager of the Rapid Transit Subway Construction Company, the view from his offices in the towers thirty-two stories high, and also the elaborate installation for the Sprague electrical elevators and the other electrical and mechanical appliances of the building which were shown to them by Superintendent Reynolds. The elevator system greatly interested the French visitors.

The event of the day, of course, was the dinner which was given at the Hotel Marlborough, at 8 P. M. Altogether between ninety and one hundred guests were present, and, despite a somewhat close and oppressive evening, passed several hours most enjoyably.

Owing to the unavoidable absence of President Steinmetz, past-president Carl Hering officiated and made a short salutatory address. Mr. Hering extended a cordial welcome to the guests, especially those from transatlantic countries, and spoke in graceful terms of the pleasure of these international meetings and of the profit and benefit that should follow a closer acquaintance of engineers of different nationalities. He called upon Mr. T. C. Martin to act as toastmaster for the evening.

Mr. Martin spoke of the extraordinary and delightful welcome which had been extended the Institute by French and English engineers last summer, and paid a high tribute to France.

The first toast, "The Land of Ampère," was responded to by M. Paul Janet, the official delegate of the French Société Internationale.

M. Janet spoke in French. He said, in part, that it was a great pleasure to him to see so many celebrated and at the same time charming people meet together in this delightful relation. France and America, he said, are the countries of electricians, and Frenchmen and Americans are practically compatriots in the advance of this science. He had been greatly pleased, earlier in the day, to see that an American town has been named for his illustrious fellow-citizen, Ampère. He went on to describe the gracious and modest qualities of this famous man of science and father of experimental electricity. "Always," said M. Janet, "a scientific idea was foremost in the mind of Ampère, and to him experiment suggested experiment and experiment was the final touchstone upon which he tested the growing ideas of his period." America had given an impulse to France in her own revolution and had led the way to that upheaval in the last years of the eighteenth century which had enabled the country to produce an Ampère, an Arago, a Becquerel and a Mascart, as well as a host of engineers, mechanics and electricians. The metric system, which is the foundation stone of modern electrical science, rests upon the work of the pioneers of the French revolution, whose idea had largely come from the example of Franklin and Washington. He spoke of the sympathy between France and the United States, and of the assistance rendered this country in its early days by Lafayette and Rochambeau. "Thus," he concluded, "French and American electricians are united by a bond of sympathy in the memorable interchange of ideas and work which has extended through more than a century." At the conclusion of his remarks M. Janet was greeted with prolonged applause.

Responding to the toast, "The Countrymen of Faraday," Mr. Norman C. Sawers, of Silvertown, England, thanked the Institute in the name of his own society, the British Institute of Electrical Engineers, for the opportunity given him to say a word in behalf of his countrymen in the field of electricity. "The names of Britons are written large on every page of the history of electrical engineering," said Mr. Sawers. "While England has been so long known as the mother and the nurse of electricity, yet she has lagged behind other nations in recognizing the potentialities of the young giant that she reared. How far behind America we are," he said, "you may judge from the frequency of our visits here to see your extraordinary works of engineering." He felt, he said, that some apology was perhaps needed for the backward state of electrical engineering in England, but Americans should not forget the antediluvian conservatism of the British public and of the legal authorities which so often had a controlling hand in electrical matters in his country. Mr. Sawers is a graceful and pleasant speaker, and his remarks were greatly enjoyed, and loudly applauded.

To respond to the toast, "The Successors of Ohm," Herr F. W. Ch. Janisch, of Berlin, had been selected, but, as the toastmaster explained, a too sudden introduction to the ubiquitous ice-water of America had temporarily incapacitated Herr Janisch, so Dr. William Hallock, of Columbia University, was called upon to respond to the sentiment.

Professor Hallock spoke of the modest way in which Ohm had introduced his great work to the world, and of the small opinion he had of his own contributions to the fundamental understanding of the subject. He spoke, further, of the important work of Gauss and Weber, of Helmholtz and Hertz, of Roentgen and Lenard. "These men and their successors," said Dr. Hallock, "are running far ahead of practice in the investigation of physical and electrical phenomena from the purely scientific side. We owe," he concluded, "no small debt of gratitude to the patient and enthusiastic investigators who have added so much to our knowledge of pure science and who are now so ably putting into practical shape the results of the scientific labors of their predecessors."

"The Heirs of Volta" was the next toast, and was responded to by Mr. P. Torchio, of New York, who is a fellow-townsman of the illustrious Volta, having been born in Como. Mr. Torchio spoke of the commercial rise of Italy and the renaissance of the fourteenth century as being closely similar to the conditions obtaining in the United States at the close of the nineteenth and the beginning of the Twentieth Century. He showed how much of the strength of American advance has been due to its foundation upon scientific study and training, and how vitally important to this country is the spirit of science. He referred briefly to the work of Volta and his successors, Ferraris and Paccinotti.

The last toast was "The Legatees of Franklin," and response to it was made by Dr. Schuyler S. Wheeler. He said that the engineers of the whole world really were the legatees of this illustrious scientist and philosopher, but that perhaps the French, owing to their early and enthusiastic appreciation of Franklin's labors, might most fitly be named his immediate heirs at law. "Franklin," concluded Dr. Wheeler, "was a practical engineer, and practice was his most distinguishing characteristic. This is our principal gift from him, and the one that we should most highly appreciate."

FRIDAY, AUGUST 16.

The programme for Friday was an exceedingly interesting and attractive one. It consisted in a visit to the various water-side electric stations in New York and Brooklyn, the steamboat Crystal Stream having been chartered for the day for this purpose.

The members and guests assembled at 9.30 A. M. in the great new station of the New York Edison Company, at the foot of East Thirty-eighth street, Manhattan, and were conducted through the plant by Mr. John W. Lieb, Jr., and a number of other gentlemen connected with the company. This magnificent station is as yet only partially completed, but is far enough

along to give a good idea of what it will be like when finished. The visitors were particularly interested in the immense engine units, each of 9,000 horse-power maximum, of which this station will finally contain sixteen.

The visit at the Edison station being finished, the boat was taken to the new station of the Manhattan Railway Company (the elevated railroad), at the foot of Seventy-sixth street, East River. This station is somewhat further along in construction than the first one seen, and great interest was taken in the work of erecting the large Allis engines, upon which a number of men were working. The four enormous Custodis brick smokestacks also came in for their share of appreciation, while the whole design of the station elicited enthusiastic approval from the visitors. Mr. W. E. Baker, the chief engineer of the electrical construction of the Manhattan company, with a number of his assistants, escorted the party through the building and explained the plant to them.

The next plant visited was the great station of the Metropolitan Street Railway Company, at the foot of East Ninety-sixth street, which was in full operation. Here the visitors examined everything, from the method of coal delivery to the switchboard. They were escorted through the building by a number of engineers of the Metropolitan company, who explained matters to them.

Reassembling on the boat about noon, a very delightful luncheon was found, served on tables on the upper deck; and while this was being discussed, the boat stood up the river and through Hell Gate, returning down the east side of the East River, and making its first stop at the Gold street station of the Kings County Electric Light and Power Company, of Brooklyn. Mr. Thomas E. Murray, who planned this station, and several other gentlemen were present to explain the details of this fine high-tension plant. This station was illustrated and described in last week's issue of the ELECTRICAL REVIEW.

The next and last visit of the day was made to the Bay Ridge station of the same company, at Sixty-fifth street, South Brooklyn, where the party spent an hour in examining the interesting plant, and were shown through by Mr. E. A. Leslie, general manager. One of the large Allis engines was in course of its preliminary "turning over," and attracted no little attention. The method of coal delivery was also minutely inspected and found very interesting.

After a false start of the boat, occasioned by some of the party being left behind at Bay Ridge, the Crystal Stream proceeded up the river, touching at the Battery and Thirty-fifth street, on the North River, thus giving the foreign visitors an opportunity to see both sides of the high-building district of the lower part of New York city.

SATURDAY, AUGUST 17.

The day was set apart for private visits and no programme features were included in it, many of the members having business to transact in New York preliminary to leaving for Buffalo.

SUNDAY, AUGUST 18.

Promptly at nine o'clock in the morning the party assembled at the foot of Forty-second street, New York, on the North River, and took the special steamboat Montauk for Albany.

The day commenced with rain and a humid atmosphere, but gradually cleared, until bright sunshine welcomed the travelers at Albany. The Montauk proved to be a comfortable boat, and Caterer Mazetti provided an acceptable luncheon as it passed the Highlands. The passage up the Hudson was devoid of incident, but the members and guests had a rare opportunity for resting, and many interested parties were made up on deck, either to discuss the scenery of the American Rhine, or to talk over the forthcoming papers on electrical topics of one sort or another.

The Montauk arrived at Albany at 7 P. M., and the party proceeded at once in special trolley cars to the Hotel Ten Eyck, where dinner was served. Early retiring was the rule, as the fatigues of the past week and anticipations of the visit tomorrow to the General Electric Company's works at Schenectady demanded abundant rest. On account of the rooming arrangements having been made on the boat, there was a pleasant absence of confusion.

In all, about 125 members and guests, including 29 ladies, took the Hudson River trip.

MONDAY, AUGUST 19.

At 9 A. M. a special train of five cars was taken at the New York Central railway station. The party arrived at Schenectady about 40 minutes later. Here the train was backed into the yard of the General Electric Company's works, and a reception committee, consisting of various officers and engineers of the company, took charge of the visitors, each guide taking several of the delegates through the various buildings. A route had been planned taking in all of the points of particular interest and showing in detail the method of manufacturing electrical machinery, especially in the larger sizes. At present these shops are very crowded with work, and the scene was one of much interest. It was noticed that the foreign guests took no little interest in the various methods of manufacture which were new to them, they being especially taken with the idea of moving the great machine tools, weighing up to 40 tons, to the work, instead of bringing the work to the tools.

At 12 o'clock the party assembled in the upper gallery of the new addition to Building 16—the largest machine shop in the United States—and here an excellent luncheon was served. At the conclusion of the luncheon, Mr. E. W. Rice, Jr., third vice-president of the General Electric Company, made a short address welcoming the Institute and the visitors to the company's works. Mr. Rice introduced Professor Elihu Thomson, who also made a few remarks. It happened that at the time Professor Thomson was speaking there was much noise, due to locomotives on the adjoining freight tracks, pneumatic hammers and other tools used on the construction work of the building, and Professor Thomson promised that when the Institute came again to Schenectady electric locomotives would be used on the switch tracks and that probably all of the 45 acres of ground would be covered by buildings which would be entirely completed.

Mr. C. O. Mailloux, on behalf of the Institute, thanked the officers of the General Electric Company for their courtesy and expressed the gratification which both the American and the foreign delegates felt at visiting these representative and very complete works.

The party then returned to the train, which left for Buffalo immediately, making only necessary stops for signals, etc. The average time maintained was about 54 miles per hour.

Upon arrival at Buffalo, at 8.30 P. M., the party proceeded as best they might, the arrangements, which had hitherto been perfect, having failed, and no one being on hand to direct visitors or show them which car line to take.

TUESDAY, AUGUST 20.

At 11 A. M. the Institute convened in its first regular session, with President Steinmetz in the chair.

Professor George F. Sever, one of the engineers connected with the electrical features of the Pan-American Exposition, on behalf of his associates and associated interests, welcomed the Institute to the scene of its labors during the convention,

and placed at the disposal of the delegates the services of the engineers and exhibitors in every way which might promote their comfort and enjoyment.

The Bell Telephone Company, of Buffalo, extended an invitation to delegates to visit any of the company's exchanges in the city, and extended also the free use of the telephones to delegates. Secretary Pope announced that the appropriate committee would take up the question of an official visit to the exchanges and probably arrange so that due notice could be given of the time of the visit.

After adjournment the party took special cars for Niagara Falls, where luncheon was eaten. The object of this visit was to view the scenic features without reference to the power stations and other engineering establishments. A short inspection of the cataract was followed by an excursion over the gorge and Canadian trolley lines and the party then returned to Buffalo in time for dinner and to see the illumination of the exposition. Both this and the falls were greatly enjoyed.

WEDNESDAY, AUGUST 21.

The meeting was convened promptly at 10 o'clock, with President Steinmetz in the chair. The airy and pleasant hall was well filled, a number of members from the West, South and Canada having joined the party over night. An invitation to visit the gorge illumination was read; also the substance in Buffalo of the Niagara transmission, and the powerhouses in Niagara. It was decided to limit time for reading and discussion, authors giving only abstracts of their papers. Paul M. Lincoln read his paper on "Synchronism and Frequency Indication." An abstract of this paper, which disclosed an interesting new method of operation, will appear in an early number. It was decided not to discuss each paper as read, but to read all on the allied topics of meters and indicators. Caryl D. Haskins then read, in abstract, his paper entitled "Some Fundamentals of Electric Meters." This was a discussion of the relation between torque friction ageing and the surroundings of the meter, these being the essential elements which meter engineers must consider. Mr. Haskins's paper was received with applause. It will appear in full in an early number. Harry P. Davis then presented an interesting paper entitled "Metering of Electrical Energy." It dealt with the mechanical and operative details of motor meters.

W. H. Browne, Jr., then read his paper on "Power Factor Indicators." Mr. Browne's paper was mathematical but very interesting, and the complete paper was well received and the discussion was then begun. W. S. Barstow opened with reference to the problem of wattless current retarding the development of alternating-current system on account of the extra station capacity necessary. Mr. Barstow discussed the subject from the commercial side and spoke of the constant comparison between alternating and direct-current systems. Mr. Steinmetz thought wattless power should not be given, or rather loaned, to customers free of charge. Customers should be compelled to buy motors that do not require excessive starting current. He discussed the points of Mr. Browne's paper at length. Mr. Haskins referred to past meetings, where the question of charging for inductive-load currents by compensating meters was discussed and decided to be a good plan.

H. W. Breck spoke of trouble increasing at stations in synchronizing machines on account of the growth of inductive loads. More accurate methods of synchronizing are necessary. Voltmeters for this purpose are not satisfactory. Large instruments, visible from any part of the station, are practically necessary. Gano S. Dunn said induction motors take much more starting current than is claimed by the manufacturers. This introduces great difficulties in station operation and any improvement removing them would greatly help the art. R. D. Mershon said there was no necessity for motors being designed to take an excessive starting current. Such motors are of the simple enclosed secondary type. When slip rings are inserted the difficulty is largely eliminated. He did not think that difficulties with heavy charging current would affect seriously the commercial status of the induction motor. It is not possible equitably to charge for wattless current. C. F. Scott said that a motor taking seven or eight times the normal running current to start must be very bad and that commercial average practice shows only two to two and one-half times needed for a few seconds. In a day's run the excess current plays a very small part since it lasts for so short a time. All the factors of operation are important. Mr. Steinmetz said that a disagreement seemed evident as to whether there was any such thing as power factor. He agreed with Mr. Mershon that induction motors requiring no excess current can be built. Dr. Dunn said a tendency existed to force an antagonism between induction and direct-current motors, but he believes no comparison is possible. Present-day alternating-current systems are superb means for power distribution using induction motors. In shop and factory equipment he did not believe the induction motor was superior in elements of cost, ease of operation or in any other particular. Mr. Mershon said nobody claimed such wide superiority for the induction motor, but he knew of no conditions under which a direct-current shunt motor can compete with an induction motor. In maintenance and many other qualities the induction motor was superior but concerning first cost he preferred to remain silent. This expression raised a laugh. Dr. Dunn warmly advocated the opposite belief and gave data of performance of direct-current motors under starting and overload. He cited a case of such motors running in graphite dust. It is difficult to obtain accurate data of maintenance of motors but no published figures show such good results as can be obtained in actual practice. He spoke at length and fully. Mr. Barstow said from a central station point of view it would be good if a penalty could be imposed on borrowed current or wattless current. Customers buy almost any kind of motor and these must be connected. Here lies the commercial difficulty.

The discussion was continued by Messrs. Mershon, Dunn, Steinmetz and others. The day's session was one of the most interesting of recent years.

The proceedings of Thursday, Friday and Saturday, with several papers, will appear in the next issue of the ELECTRICAL REVIEW.

Fishing by Electric Light.

The Yale submarine arc light, which was invented by Mr. Francis G. Hall, Jr., and Irving E. Burdick, of New York, graduates of Yale in the class of 1900, is to be used for fishing. Their submarine light has been used successfully in diving work. It is asserted that electric lights not only fascinate large fish, but even blind them long enough to enable strong nets to haul in schools of them. The ultra-violet rays given off by electric arc lights stun the fish because of the great dependency they place on their sense of sight. The arc lights will be placed on four specially constructed boats built for W. S. Mead, of New York. They will be put into actual practice in the Pacific Ocean, off the coast of California. Four submarine arc lights are to be placed on each of the boats. Each lamp will be of several thousand candle-power. Wood is the material to be used in the boats, because it deadens the noise of the machinery and lessens the vibrations due to it. These vessels are being constructed by the Naval Electric Company, of New York, with which Messrs. Hall and Burdick are connected.

National Association of Municipal Electricians.

The sixth annual convention of the National Association of Municipal Electricians will be held at Niagara Falls, September 2, 3 and 4, with headquarters at the International Hotel. A number of papers will be presented and discussed, among these being the following:

"Need and Value of a Set of Rules for Outside Construction," by P. H. Trout, Jr., city electrician, Lynchburg, Va.

"Underground Electric Construction, from a Municipal Standpoint," by Edw. F. Schurig, city electrician, Omaha, Neb.

"Inadvisability of Placing High and Low-Potential Wires Through the Same Series of Conduits, or Through the Same Manholes."

"The Protection of Fire and Police Telegraph Wires from High-Tension Currents and Lighting," by W. M. Petty, superintendent fire telegraph, Rutherford, N. J.

"Improved Storage Battery for Municipal Purposes," by J. W. Aydon, superintendent fire and police telegraph, Wilmington, Del.

In addition, an excellent programme of entertainment for the members and guests has been arranged by Mr. M. J. Donohue, chairman of the executive committee. The programme, of course, will include a trolley ride over the Gorge railroad and a visit to the Pan-American Exposition, at Buffalo.

President McFarland, of the Old-Time Telegraph Association, has arranged for one fare for round trip excursion from Toronto to Montreal for all those who wish to attend the old-timers' and U. S. telegraph convention at Montreal the following week.

Automobiles for Fire Departments.

The Paris fire department has been experimenting with different types of electric automobiles, such as fire pumps, hook and ladders, hose carriages, etc., and these have proved very successful in general. By them a decided advantage over the old forms is presented, in allowing a quicker start from the station and an immediate putting in use when on the ground. The value of this increase of speed is apparent, since a gain of only a few minutes may be of vital importance. The first machine to be tried was the *"fourgon,"* or wagon, carrying six men, hose, ladders and fire extinguishers. The motor, of the Boquet, Garcin & Schivre type, is of 4,000 watts capacity, and the accumulators, which give 200 ampere-hours, weigh 1,500 pounds. This vehicle measures about six by ten feet and weighs 4,840 pounds, or 6,820 pounds when in running order. The electric fire pump was the next to be tried. It carries a pump worked by an electric motor and fed by a water reservoir containing 150 gallons; this water supply (or other fire-extinguishing liquid) is utilized until the hose can be connected directly to a fire-plug. The same motor is used to drive the vehicle and, when on the spot, to work the pump. In this way it starts almost instantly and, upon arriving at the fire, sets immediately to work. It has a front seat with the steering devices and in the centre is the battery box, suspended below the vehicle; above it is the motor, of the same type as the first vehicle, which drives the rear wheels. The reservoir is in the rear and above it is the hose reel, the water being taken to the hose through the hollow axle. The pump, back of the reservoir, has three vertical cylinders, and delivers 20 gallons per minute at a pressure of four atmospheres. The vehicle has an electric brake, besides a cord brake; it weighs 5,060 pounds, or 6,380 pounds when fully equipped, including three men and 100 gallons of water. The motor gives 4,000 watts and the accumulators 180 ampere-hours. An arrangement is provided for using part of the current for lighting the scene of disaster by incandescent lamps, or even by arc lamps. These two machines have been repeatedly tried in actual service and have proved quite successful. A newer machine is the hook and ladder, which is rather in the experimental stage.

Insulating Power of Electricians' Gloves.

The Central Electric Laboratory, of Paris, has recently carried out a series of experiments bearing on the degree of insulation of electricians' gloves. The tests were made both with low pressure and high pressure. The practical conclusion arrived at is that insulating gloves can not be considered to afford efficient protection against the dangers surrounding high-tension currents; it would even be preferable to proscribe their use altogether rather than rely upon their efficiency in the contact with dangerous connections. It is prudent only to consider them useful for working those parts already insulated from the lines, such, for instance, as non-metallic handles of switches. One glove, which withstood a potential difference of 12,200 volts, got pierced in one minute; another kind was pierced after three minutes with a potential difference of 1,000 volts only.

Telephoning and Telegraphing Simultaneously.

To the Editor of the Electrical Review:

Your inquiry with regard to our simultaneous telephone and telegraph scheme received. It was not intended at this time to give the matter the publicity it has received. However, I will explain that the arrangement is an improvement over older attempts at a solution of the problem, rather than an entirely new invention. I simply worked out the scheme for adding to a metallic circuit telephone line a telegraph auxiliary. Special means are provided, first, for balancing the telephone pair to eliminate inductive disturbances; second, for entirely obliterating disturbances in the telephones from the telegraph auxiliary. I am not at liberty to give you the details of the arrangement at present, but will state that the experiments on our St. Paul-White Bear lines were entirely successful, and that we contemplate installing the apparatus on our Tacoma-Seattle circuit within a short time.

C. H. Gaunt,
Assistant Superintendent of Telegraph,
Northern Pacific Railway Company.
St. Paul, Minn., Aug. 19.

Another System of Wireless Telegraphy.

A member of the technical committee, which has been engaged in making some definite experiments in wireless telegraphy on the system of the Spanish major, Cervera, has made some statements regarding it, as follows: "The results have been splendid; the major has telegraphed with complete success between Tarifa and Ceuta (*i. e.*, across the Straits of Gibraltar). He will shortly telegraph from Barcelona to the Balearic Isles. Major Cervera is even certain that he will be able to telegraph from Spain to America. His system is said to have a great advantage over Marconi's, in that it does not permit of the despatches being intercepted. Near Alicante the major has fired mines at a distance without wires. He hopes to be able to effect the explosion of the magazines of warships at a distance. The Spanish Government has bought 100 of Cervera's apparatus, and a Belgian company is offering 250,000 francs for permission to work the invention in Belgium."

In Cleveland, Ohio, street sweeping by trolley is being tried. An eight-foot broom sweeps the space between and just outside the rails and a 16-foot broom sweeps at the side. Credit for the application of sweepers to street cars is given to Mr. I. A. McCormick, general manager of the Cleveland Electric Railway Company.

Magnetic Brake and Electric Car-Heating Apparatus.

The necessity of using some form of power brake in connection with electric railway cars operating in urban and interurban service has long been apparent to advanced street railway managers who wish to secure the very best possible results as regards speed and safety. With a very broad experience in all matters relating to the design, construction and operation of brake apparatus, and with facilities for manufacturing various types of air brakes suitable for application either to steam or electric railway cars, the Westinghouse Air Brake Company, of Pittsburgh, Pa., has designed its electric brake and car-heating apparatus.

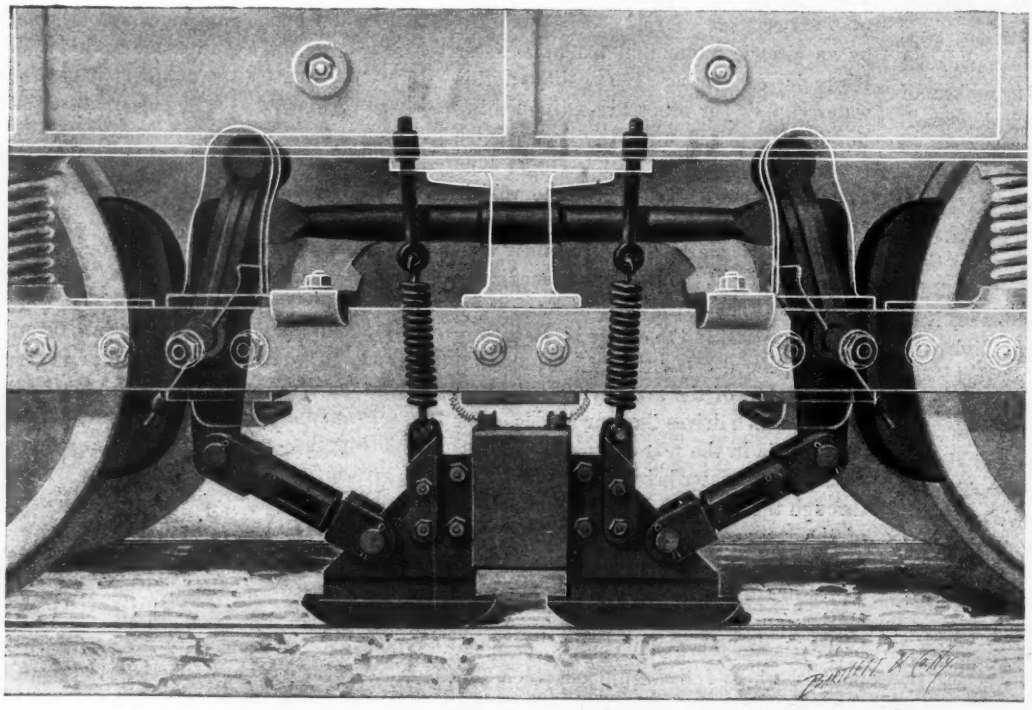


FIG. 1.—MAGNETIC BRAKE, SHOWING METHOD OF ATTACHING TO CAR FRAME AND TRUCKS.

A much greater braking effect than that generally attained is produced by a simple and ingenious combination of a magnetic track brake with a wheel brake of maximum power. Besides this, cars equipped with the complete apparatus can be comfortably heated in winter without the use of line current, and, consequently, without cost.

The brake proper comprises a double-track shoe of peculiar construction, combined with a powerful electromagnet, which, when energized by current produced by the car motors acting as generators, is strongly attracted to the rail by magnetic force; and brake heads and shoes of the ordinary type, acting directly on the wheels and constituting a wheel brake of maximum power and efficiency; and sundry castings and forgings for

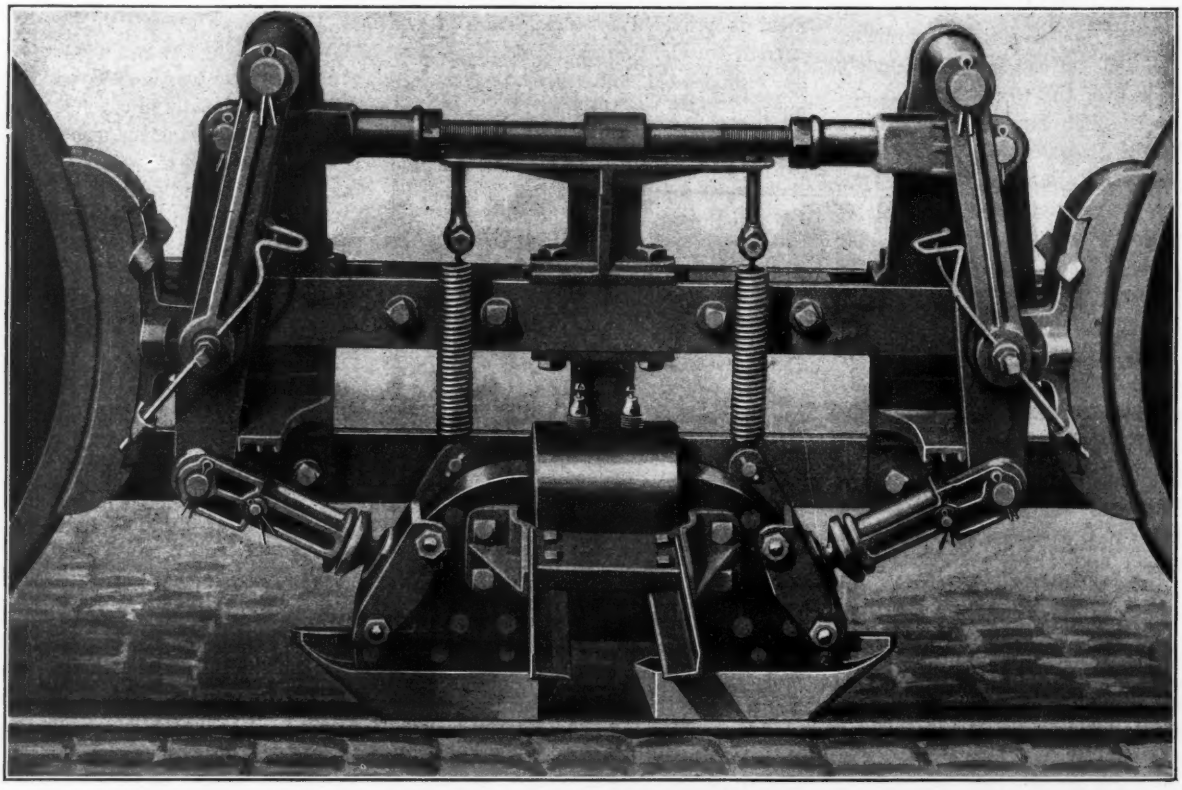


FIG. 2.—VIEW OF MAGNETIC BRAKE FROM UNDER CAR.

transmitting simultaneously the downward pull and resultant drag of the magnetic track brake into lateral pressure upon the wheels. The combination of these three elements in duplicate, together with the necessary tie-rods and attachments, constitutes a single-track equipment designed for application to a four-wheel, or single-truck, car. A double-truck equipment, being equivalent to two single-truck equipments as described, is required for an eight-wheel, or double-truck, car.

FIG. 3.—INTERIOR OF CAR, SHOWING HEATER.

In the first illustration a portion of the truck frame is shown as transparent, which affords a clearer view of the mechanism connecting the track and wheel brake, and illustrates the general arrangement and substantial construction of the apparatus. In Fig. 2 a view of the brake from under the car at a point midway between the trucks is depicted.

The car heaters made by this company occupy no valuable space in the car, are easily controlled and cost nothing to operate. They are connected with the general system of wiring by means of a suitably arranged switch so constructed that the braking and starting currents, both of which are used for heating the car in cold weather, may be divided as desired and the whole or any portion thereof sent through the heaters, the remainder going through the proper portion of the diverter beneath the car. An important advantage of this heater is its great capacity to store and retain heat within its mass. In Fig. 3 the location of the heater in the car is shown, and in Fig. 4, the diagram of the wiring.

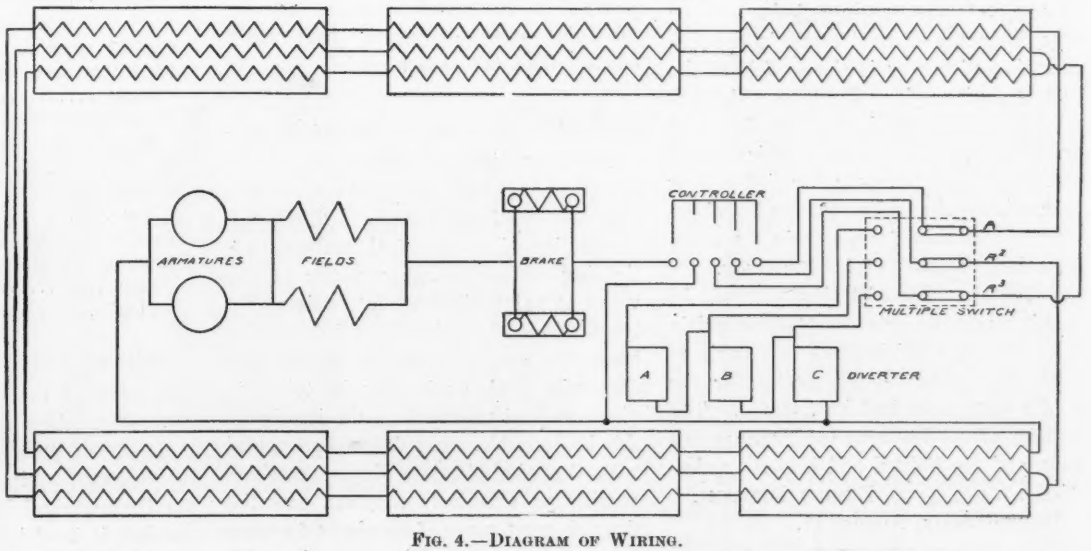


FIG. 4.—DIAGRAM OF WIRING.

Military Automobiles in England.

Military automobiles are to receive a severe test in England. The Minister of War has announced a concourse of automobiles. Three prizes are offered; $2,500, $1,500 and $500. These prizes are to be awarded by a special commission after a series of tests which will commence December 4. The following are some of the conditions laid down for the tests: The vehicle must be able to run upon bad roads and even across fields. The total load carried is to be five tons, of which the tractor carries three and the rear wagon two. The platform surface is to be 15 square feet per ton. The tractor and wagon must be supplied with movable side pieces two feet high. The platform of the tractor, when empty, must be at most four feet three inches from the ground, and that of the rear wagon four feet. The train, when loaded with its five tons, is to give the following results: 1. A speed on level grades of eight miles an hour. 2. A mean speed of five miles an hour upon average roads with up and down grades. 3. Upon the road it should, while fully loaded and by its own aid, mount grades of one in eight. All the parts of the mechanism are to be protected against accidents, mud and dust. The controlling mechanism is to be strong and powerful. The train should give 48 hours' work without extra attention or repairs. The driving wheels are to have a diameter of at least four feet six inches. There is no restriction as to the choice of the combustible or type of motor.

SUCCESSFUL TEST OF THE GANZ SYSTEM.

THE FIRST TRIALS OF THE VALTELLINA, ITALY, ELECTRIC RAILWAY SURPASS EXPECTATION.

[*Special Correspondence.*]

The preliminary trials upon the lines of the Valtellina Electric Railway, described in the ELECTRICAL REVIEW August 10, 1901, have been begun and continued for several days. The results have surpassed expectation and the engineers have been more than satisfied with the stability and operation of all parts of the installation from the first. They are especially pleased with the behavior of the electric automatic appliances. The dynamos work perfectly at 21,000 volts, and the turbine machinery gives entire satisfaction. The first line has not given the least trouble, although the initial trials have taken place in the period of the heavy July rain-storms.

The rolling stock gives entire satisfaction. At a speed of 72 kilometres per hour (about 45 miles an hour) there is no severe jarring in the cars. The manipulation of the controller is very easy and sure. For traction service it has been thought that each train ought not to consist of more than three ordinary passenger cars of about 30 tons total weight; but, on the contrary, the system has shown itself capable of transporting five cars, and preserving a speed of 72 kilometres per hour, even on the grades, which are not small on the Colico-Sondrio part of the system. In the descent of inclines of 14 per cent, the starting of the train is very gradual, and the decrease in the consumption of energy is clearly felt at the central station, where the gates which admit water to the turbines are partly closed until the motors again take their normal current. Very many other interesting properties of three-phase motors have been verified and they form certainly a cause for a large amount of further study.

A large number of trains will soon be running each way on the Colico-Sondrio line, and the officials hope to be able to establish a much better service for the public than they had anticipated. The cars are of the Pullman type, 17.5 metres long, and are lighted and heated by electricity.

ENRICO BIGNAMI.

Lugano, Italy, August 11.

Trolley Roads to Combine.

Plans are being considered for a combination of electric street railways and interurban trolley lines which will, if made, be the greatest system of electric roads in the country. It includes roads covering Cleveland, Toledo, Sandusky and Detroit. The men who are at the head of the scheme are Henry A. Everett and E. W. Moore, of Cleveland; W. L. Elkins, P. A. B. Widener and a number of Philadelphia and New York capitalists are also said to be interested. The capital of the company will be over $100,000,000, and the plan contemplates the exchange of new securities for the securities of the companies now in existence.

The following table, which was prepared in Philadelphia, the headquarters of some of the biggest traction companies in the country, gives a list of the lines which may be acquired, with their mileage and combined stock and bond issue:

	Mileage.	Stocks and Bonds.
Cleveland Electric	136	$17,350,000
Cleveland City	36	10,000,000
Lorain & Cleveland	24	1,750,000
Northern Ohio Traction	95	6,500,000
Cleveland & Chagrin Falls	41	800,000
Cleveland & Eastern	40	2,200,000
Cleveland, P. & Eastern	38	2,500,000
Sandusky & Interurban	53	920,000
Sandusky Nor. & Southern	21	540,000
Toledo Traction	104	24,000,000
Toledo, Tremont & Norwalk	62	3,000,000
Detroit United Railway	204	23,500,000
Detroit & Northwestern	60	1,400,000
Detroit & Pontiac	40	1,000,000
Wyandotte & Detroit	11	25,330,000
Port Huron Rapid Railway	116	4,000,000
Detroit & Toledo	60	4,000,000
Total stocks and bonds		$128,790,000

It is proposed to operate freight and express cars over the various lines and to compete for both freight and passenger traffic with the steam railroads. It is planned to have trains run on regular schedules and to operate them much oftener than the steam roads.

Electric Light from Antarctic Winds.

The ship Discovery, which is about to start from England for the Antarctic seas on a voyage of exploration, is fitted with a most ingenious electrical appliance for lighting when the steam power of the vessel is not available. It consists of a large windmill, which may be used on board the vessel should it be necessary to economize fuel, or it may be taken to pieces and set up again on the ice should this be desirable. The dynamo connected with the windmill is a duplex machine causing an effectively constant potential through great range of speeds. Of course, accumulators are used in connection with the outfit. The apparatus was designed by Mr. Arthur Bergtheil, of Messrs. Bergtheil & Young, British representatives of the Bullock Electric Manufacturing Company and the Wagner Electric Manufacturing Company, of this country.

The Boston Electric Light Company.

The annual meeting of the Boston Electric Light Company was held last week. The treasurer submitted the following figures covering operations for the year ended June 30:

1901.	
Gross Income	$1,036,950
Operating expenses	545,866
Profits	491,084
Profit, sale real estate	142,672
Total	633,756
Int. charges	84,958
Net for stock	548,798
Dividends	270,000
Surplus	278,798

The following directors were elected: C. L. Edgar, W. C. Baylies, T. Jefferson Coolidge, Jr., George Dexter, C. Minot Weld, Henry B. Cabot, Edward B. Maltby, Isaac T. Burr and Everett W. Burdett.

Of the above, the first six represent the Edison Electric Illuminating Company on the board. Mr. Burdett was reelected treasurer and clerk.

All the stock except a few hundred shares has been deposited for exchange for Edison company stock.

The company presented the following balance sheet of June 29:

ASSETS.	
Plant accounts	$2,539,630
Real estate accounts	940,180
Underground conduits	747,141
Underground cables	915,704
Supplies, tools, teams and office furniture	96,455
Cash	207,348
Accounts and notes receivable	199,917
Total	5,646,377
LIABILITIES.	
Capital stock	$3,000,000
First mortgage six per cent bonds	293,000
Consolidated first mortgage five per cent bonds	957,000
Accounts and notes payable.	562,816
Balance to credit of profit and loss	703,072
Reserve for depreciation	120,000
Reserve for liability insurance	10,488
Total	5,646,377

Railway Enterprise in Hungary.

In view of the prominence which has lately been given to the firm of Ganz & Company, of Budapest, in connection with the projected equipment of the Metropolitan Underground Railways of the city of London, it is of interest to note the proposals of the company in other countries. A message from Budapest states that the firm is now making investigations and preparing plans at the instance of the Minister of Commerce and Finance, at Budapest, with a view to the introduction of electrical working on the main lines of railways in Hungary.

Enamel Resistances.

A metal shell, or casing, is used in the construction of the type of resistances which is shown in the accompanying illustrations. Within this shell is contained the resistance in a thin layer of vitreous insulation, which completely surrounds and hermetically seals it. This insulation is also held in close contact with the inner walls of the metal casing. By this means an apparatus is provided in which the resistance is sealed in a high insulating material so disposed with reference to the metallic casing that it provides rapid conduction or flux of heat to the metal casing, the outside of which is the dissipating surface.

One object has been constantly kept in mind in effecting the details of this apparatus, namely, to work out a construction which will make a good resistance for a number of years, provided it is not abused too greatly, an illustration of which is the method employed in fastening the terminal points to the resistance. An iron or copper screw is used in the case of each terminal for bringing the current from the resistance within the iron casing to the terminal points without. This copper or iron screw is brazed securely to the resistance conductor, the brazed joint being sealed within the vitreous insulation.

To secure mechanical strength and provide considerable cross-section for the rapid conduction of heat from one part of the plate to the other, an iron shell, which is comparatively heavy, is employed, which keeps the temperature quite uniform throughout the surface of the plate regardless of the steps in circuit.

These plates are made in four sizes, namely, 4 by 8, 5 by 12, 7 by 14 and 7 by 21 inches. They are substantially as represented in Fig. 4. They appear as shown in Figs. 2 and 3 when banked together,

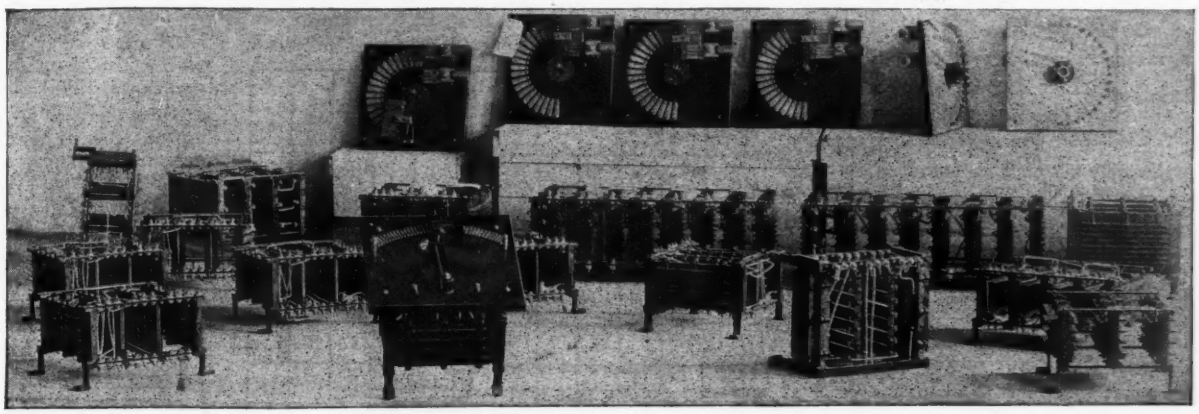
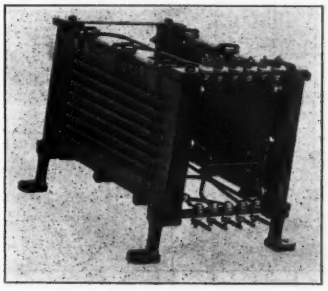
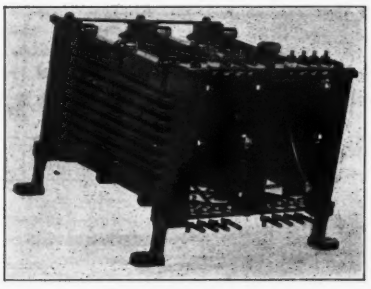


FIG. 1.—TYPES OF ENCLOSED RESISTANCES.





FIGS. 2 AND 3.—ENCLOSED RESISTANCES BANKED TOGETHER.

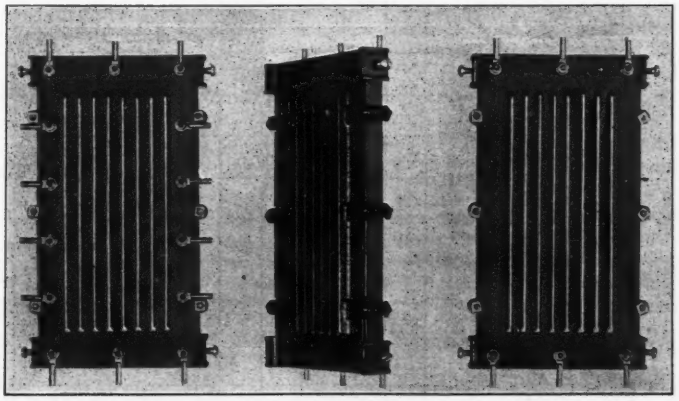


FIG. 4.—RESISTANCE PLATES.

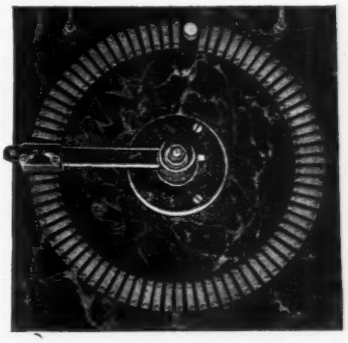


FIG. 5.—REGULATOR FOR ORGAN-MOTOR.

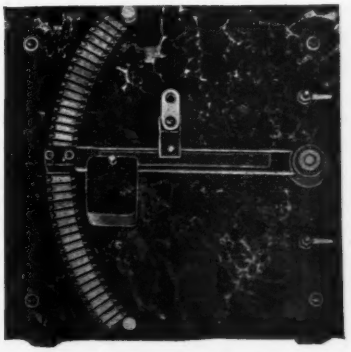


FIG. 6.—SWITCH FOR FIELD CONTROLLER.

and furnish a construction which is comparatively compact and yet admits of free ventilation. When the plates are thus banked together for convenience the terminals are all brought out to a common iron strap on one edge of the plate, where a terminal connector bored for a proper size cable is provided for each terminal of the resistance. This type of resistance is suitable not only for continuous regulation, but also equally suitable for intermittent and starting service. It is particularly adapted to use in damp locations, such as mines, or where the apparatus is likely to be exposed to the weather, since there is nothing which dampness affects, the only materials entering into its construction being metal, glass and resistance material, combined in one solid mass. A complete line of self-contained switches has been devised for different kinds of service in the manufacture of rheostats where these are particularly desirable. Except for very small current, round button contacts have not been employed, but sector-shaped pieces.

Multiple-contact fingers are employed in union with the sector-shaped pieces, not less than two in number, their number depending upon the current capacity of the switch. These multiple contact fingers each consists of a copper block pressed down upon the switch block by steel springs and driven by steel pins. The current is carried from the switch-arm to the contact fingers by a small flexible cable. The contact fingers are of standard parts made by special machinery, as well as the steel pins, springs and other parts which work in combination with them. By this arrangement they may be replaced easily and cheaply in case of accident. With this design the contact may be made very effective between the switch-arm and the contact blocks without the friction commonly incident to switches of considerable capacity.

A switch of an organ-motor regulator is depicted in Fig. 5. The weight and also the swivel attachment for the cord in this apparatus are adjustable by means of a set screw, entirely independent of each other, and almost the entire length of the switch-arm. This, in connection with the multiple contact fingers of the construction above described, gives the perfect freedom of movement, together with the sector-shaped contact pieces. This freedom of movement is extremely essential in an apparatus of this character which must work automatically.

A switch which forms part of a field controller arranged for the back of the board is shown in Fig. 6. It has 75 steps, or divisions, of the resistances, and is the type of switch designed for back of board field controllers, as well as for other similar apparatus. In Fig. 1 is given a view of a number of different instruments.

The large switches in the background are for mounting on the back of a switchboard controlled by a hand-wheel on the front. These switches are used for starting large rotary transformers with about 100 amperes starting torque and 700 amperes continuous capacity on the short-circuit position when the knife-blade switches are engaged. The cut shows some of the resistances to be used in connection with these switches. In the foreground an organ-motor regulator is also shown.

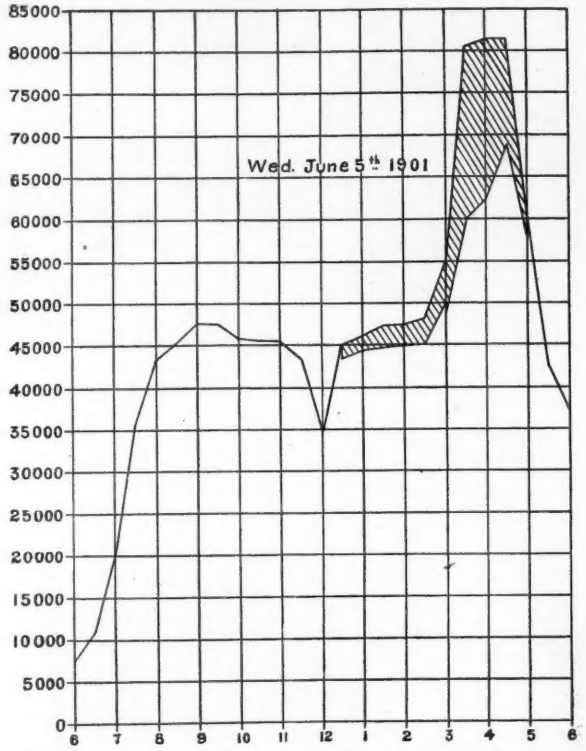


FIG. 1.—DIAGRAM OF STORAGE BATTERY WORK IN CHICAGO EDISON STATION.

The Carpenter Enclosed Resistance Company, New York, manufactures the apparatus which has been described above. Mr. C. E. Carpenter, its vice-president, is prominently known in the rheostat and resistance work, and it is believed that he was the first person to form a company especially devoted to their manufacture, organizing it in the spring of 1892. Since that time he has devoted himself almost exclusively to the production of rheostats of all descriptions. These rheostats are now almost universally used for controlling the speed of small motors and the speed of dynamos.

Accumulators for Station Emergencies.

Among the many problems which confront the manager of a central lighting station, one of the most troublesome, especially during the summer season, is that which is caused by the sudden load thrown on the station by a thunder-storm—the overcast sky causing thousands of lights to be turned on for a period of from half an hour to possibly several hours. This creates a peak for which no preparation has been made, necessitating firing up an extra boiler and starting additional generating units, all of which takes considerable time. Possibly by the time steam is generated the storm has broken, and the necessity for the extra work has passed.

In no way can the usefulness of an installation of accumulators be better shown than in just such an emergency load, and the accompanying diagrams, which show their operations in the battery stations of the Chicago Edison Company on a "dark day," are striking illustrations of the manner in which the battery "helped them out."

Both of the curves on this page show, in the shaded portions, the work done by the battery, which is of the chloride type.

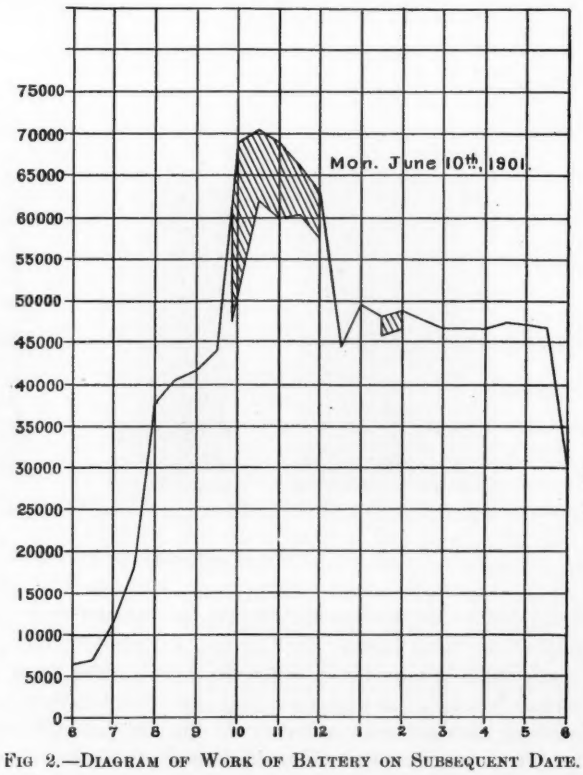


FIG 2.—DIAGRAM OF WORK OF BATTERY ON SUBSEQUENT DATE.

Current Electrical News

COMMERCIAL NEWS

DOMESTIC AND EXPORT

According to a despatch from Stockholm, the Swedish Government is considering plans for the installation of electricity upon all the railways in Sweden.

The Brooklyn Rapid Transit Company will restore electricity as the motive power on all the elevated roads on September 1. It is stated that the company will make this move because of the decrease in receipts of these roads owing to the use of steam engines.

Thomas Jansen, chief clerk at the National Bank of the Republic, in Chicago, Ill., has invented a photographic check-recording apparatus which is operated partly by electricity. With this the checks can be photographed at the rate of 10,000 an hour, and it is expected that this apparatus will do the work of nine clerks.

What is said to be the first planing mill run by electricity in this country has begun operations on Goose Island, near Tonawanda, N. Y. Mr. Frank J. Allinger, the owner, has installed two motors of 125 horsepower each, which suffice to run all the machinery in the mill. He thinks that he will make a great saving in fuel by substituting electricity for steam, as he uses power only according to the machines operated.

The stockholders of the Reading & Southwestern Electric Railway Company, of Reading, Pa., have agreed to lease the line to the United Power and Transportation Company for 999 years. The United company is to pay the interest on $100,000 in bonds, and an additional rental of $15,600, which is sufficient to pay 12 per cent on the par value of the Reading & Southwestern stock. The United company in case of default, forfeits a bond of $20,000, and in addition is compelled to pay $50,000 damages.

The lighting of the Suez Canal by electricity is being contemplated so that all shipping may pass through at night. It is not certain that this will be done at once, as there is no imperative need for it at present, since 90 per cent of the ships passing through the canal are now provided with electric lights, and are therefore permitted to pass through at night. By this improvement the time of passage has been considerably reduced. It now is about 15 hours and 40 minutes.

The property of the Toledo Traction Company, of Toledo, Ohio, has been transferred to the Toledo Railways and Light Company, a part of the Everett-Moore Syndicate. The consideration involved was $9,000,000. It is announced that $1,000,000 will be expended on the improvement of the property. Mr. E. W. Moore announces that the purchase of the Toledo, Fremont & Norwalk Railway by the Everett-Moore Syndicate has been concluded, and that the money for the property has been turned over.

The representatives of the Tokio Consolidated Street Railways of Japan, who have been in the United States for the purpose of making some investigations of electric railway apparatus previous to placing an order for three 1,200-kilowatt generators and several motor equipments, have secured all the necessary data. The propositions of the bidders have now been submitted to Japan, and a cable is momentarily expected from there regarding the placing of the contract. It is stated that the bids represent an expenditure of at least $400,000.

According to the consular reports, the government of Hungary is anxious to interest capitalists in establishing manufactories of various kinds in that country, and will grant valuable concessions to investors in order to promote a revival of the industries and the prosperity of the business world of Hungary. The government will grant subsidies for a barrel factory and asbestos factory, an establishment for the manufacture of articles of lead, tin and zinc by electricity, a silk factory, a cotton spinning and weaving factory, a woolen yarn mill, and an agricultural machinery factory.

The report of the United States Consul-General at Yokohama, Mr. E. C. Bellows, brings out with great clearness the importance of the commercial relations between Japan and the United States. The United States has almost one-fourth of the entire volume of trade with Japan, which largely exceeds the trade between Japan and any other nation. It holds the supremacy in the importation of the following-named articles: Raw cotton, bicycles, tricycles, electric light apparatus, mining machinery, electric light wire, telegraph wire, materials for bridges and buildings and many other things.

The important contract for the electrical conversion of the Mersey Railway has been awarded to the British Westinghouse Electric and Manufacturing Company, Limited. The road extends from Liverpool to Birkenhead under the River Mersey and is about two miles in length. American equipment of American manufacture will be used, which will be built principally in Pittsburgh. The construction of the Westinghouse plant at Trafford Park, near Manchester, is being pushed forward rapidly, some 2,600 men being now engaged on the work. The Lord Mayor of London, accompanied by other British civic dignitaries, will shortly lay the corner-stone of the new plant.

The establishment of an electric light installation in Ipswich, England, is being considered. This seaport is on the east coast of England and is doing a steadily increasing shipping business with the United States. Professor Kennedy, the well-known British electrical expert, has been consulted as to the probable initial expenditure, and has estimated that it will be about $300,000. The following are the details of his estimates: Boilers, $25,000; six engines and dynamos, $56,000; storage batteries of 300-ampere-hours capacity, $4,500; switchboards with boosters and connections, $12,000; station buildings, $115,000; mains and feeders, $42,000; meter and house connections, $4,000; 85 arc lamps and posts, $14,500, and engineers and architects' fees, $14,000.

The officials of the Chicago & Great Western Railroad are contemplating the installation of electric motive power for the road's suburban service from St. Paul, Minn., to Randolph, a distance of 30 miles. The chief engineer has prepared estimates and plans for the proposed change from steam power, and has already submitted two plans to the company, one of which calls for a third-rail system, and the other for an overhead trolley with return circuit. The Great Western has a heavy suburban business between St. Paul and Randolph, and other suburbs within 30 miles of there. The packing-house industries in St. Paul have grown to such an extent that they promise to shortly increase the traffic to twice its present size, and the road is seeking more economical and effective means for handling its increased business.

Three suits have begun in the United States Circuit Court against the Lorain Steel Company. The General Electric Company is the complainant in two of these suits, and the Thomson-Houston Electric Company in the other. All of them are for infringements of patents alleged to be owned by the complainants. The General Electric Company claims to own the patent for an arc-rupturing device which was granted to Elmer A. Sperry in October, 1894, and a patent for electric brakes granted to William B. Potter in January, 1895. The complaint of the Thomson-Houston Electric Company is based on an alleged infringement of a patent for electric motors granted to Francis O. Blackwell in June, 1899, and subsequent improvements on these patents.

In India electricity is a good deal in the air at present and American manufacturers ought to secure good orders. Many of the large towns in the north, such as Cawnpore and Lucknow, have schemes in hand for electric tramways and lighting. The government is to erect a new carriage factory at Jubbulpore which will have electricity for its motive power, as will also the Cordite factory at Wellington. It is also decided to light all parks with electricity and to arrange for punkahs to be pulled by the same means. Punkahs are being gradually abolished in Calcutta, and electric fans substituted in their place. Portable electric fans, which are driven by small batteries, are selling in large numbers all over India. The Bombay electric tramway scheme is in abeyance due to litigation between the present company and the corporation.

Signals from a 30-inch searchlight, on the electric tower of the Pan-American Exposition, were sent to Niagara Falls, July 25, by Professor George F. Sever, superintendent of electrical exhibits, in the presence of the electrical jury, thus demonstrating the feasibility of this method of signaling at night. Since that time searchlight signals have been sent from Buffalo to Toronto, a distance of 58 miles, through arrangements completed by Professor Sever in cooperation with Mr. Wm. S. Aldrich, consulting electrical engineer, of Toronto. The first trial was made at 9.10 P. M. August 9, with clouds over Toronto. The local illumination of the overhead sky by the electric arc lights in the streets of Toronto effectually prevented any discrimination being made between the local and the Buffalo illumination of the clouds. The second trial was made at 9.50 and 10.15 P. M. August 13, with a perfectly clear atmosphere. Owing to the smoke settling down over the city, no signals could be discerned from the top of the Municipal Hall tower, Toronto. This was the prearranged objective point for both experiments. Special long-distance communication was arranged between the top of the tower and the electric tower, at the Pan-American, through the courtesy of the Bell Telephone Company, represented by Mr. Dunstan, of Toronto, so that every detail of the experiment could be followed. The special instructions were to depress the searchlight to the lake horizon, bearing on the Municipal Hall tower; then to sweep the horizon a definite angle, to the right and left of this bearing, and later to elevate and depress the light on the original bearing. All of these signals were very clearly discerned during the second trial by Mr. C. H. Rust, city engineer, Toronto, with a party located on Centre Island, two miles off shore from the city.

ELECTRICAL SECURITIES

There was an improvement in trade during the week and fall business may be said to have opened actively. There are more cheerful reports from the corn belt, and this had a noticeable effect on the stock of the grain-carrying railroads. Stock market prices improved in general, apparently without regard to the news regarding the steel strike. It seems to be the prevalent opinion that the failure of the western members of the Amalgamated Association to break their contracts and go on a strike, has put the success of the present strike absolutely out of the question. Chicago iron interests are said to be getting much business, diverted from eastern markets by the strike. A very large demand throughout the country for structural materials is to be noted.

The supply of money in the New York loan market is apparently quite ample, call loans being made on the basis of two and three per cent. Commercial paper is active. Investment buying of dividend paying stock is reported to be in evidence, and a steady absorption of securities of excellent quality has caused an advance of quotations. During the week foreigners have purchased a large amount of American stocks.

It seems to be the general view of Wall street men of experience that a stable market situation is to be expected, and it is not likely that the heavy speculations of the first few months of the year will be repeated. Among the electrical stocks there was a noted advance in General Electric, which reached 265, an advance of 15 points for the week. The traction companies were somewhat heavy, declining a point or two at the end of the week.

ELECTRICAL SECURITIES FOR WEEK ENDING AUGUST 17.

New York:	Highest.	Lowest.	Closing.
Brooklyn R. T....	75¾	72⅞	73¾
Con. Gas.....	225	219	221¼
Gen. Elec.....	265	250	265
Man. El.....	118¾	115½	116½
Met. St. Ry.....	168¼	166	166
Kings Co. Elec....	...	...	197
N.Y. & N. J. Tel. Co.	...	...	175
Telep.,Tel.&Cbl.Co.	...	...	3

The preferred stock of the General Electric Company has been stricken from the stock exchange list as most of the issue has already been exchanged for the common stock of the company.

An official of the Westinghouse Electric Company is reported as saying: "It is impossible to give any accurate figures at the present time, but our company during present fiscal year will make an exceptionally fine showing. Earnings during past six months were by far the largest in our history, and there is every reason to believe that a new record will be established during the next half year."

Boston, August 17:	Closing.
Am. Telep. & Tel.....	163
Erie Tel.....	47½
New Eng. Tel.....	140
Mass. Elec. pf.....	93
Westing. Mfg. pf.....	71½
Edison Elec.....	260

The *Boston News Bureau* states: "The sight of a number of empty tenements along the line of the elevated structure of the Boston Elevated has given rise to the impression that the company will have extensive damages to pay upon this account. The original estimates presented to the railroad commissioner at the time the company obtained leave to issue $10,000,000 of capital made liberal provision for this class of damages, the minimum estimate being $3,120,000, and the maximum $5,029,000."

It is announced here that President C. A. Coffin, of the General Electric Company, will in the immediate future spend a large part of his time abroad placing the British Thomson-Houston on a financial basis more in line with American ideas. The foreign field for electrical equipment is growing very rapidly, and it is said to be Mr. Coffin's idea that the business of the British company can easily be trebled.

Philadelphia, August 17:	Closing.
Elec. Co. of Amer.....	7¼
Philadelphia Elec.....	5¼
Union Traction.....	28⅛
United G. I. Co.....	115
Elec. Stor. Bat. c.....	77
Elec. Stor. Bat. pf.....	78

The Electric Company of America, it is announced, has purchased the electric lighting plant at Canton, Ohio, and at Auburn, N. Y., two prosperous companies. The United Gas Improvement Company has liquidated its interest in the Electric Company of America, and this unloading was the cause of the recent decline in the stock. The stock is again quoted at an advance. The companies owned are all dividend paying.

Chicago, August 17:	Closing.
Chicago Edison Light.....	168
Central Union Telephone.....	45
Chicago Telephone.....	275
Un. Trac.....	16¼
Un. Trac. pf.....	59
Metropolitan El.....	92½

The Chicago Union Traction Company's earnings for the first 10 days of August are stated to be $20,000 more than the earnings for the same period last year. The increase in July was $66,000 and in June $53,000.

The directors of the Central Union Telephone Company have decided to raise $3,500,000 for the rapid development of the company's property. This will be done by reducing the present issue of capital stock one-half and then increasing the capital stock so reduced 100 per cent, which will bring into the treasury substantially the amount desired. The company has outstanding $6,962,100 stock. Reducing this amount one-half would make the capitalization $3,481,050. If, in increasing the reduced amount 100 per cent, the new stock were issued at par, the sale of the new shares would produce $3,481,050, which is about the amount President Sabin declares is necessary to put the property on a stable dividend-earning basis. The value of the stock after the reduction and the increase have been completed ought to be about 97. The price now rules around 47.

The Illinois Telephone and Telegraph Company has recorded a mortgage to secure an issue of $5,000,000 five per cent 30-year gold bonds. Only part of the bonds have been sold, J. B. Russell & Company, of Wilkesbarre, Pa., being the purchasers.

MISCELLANEOUS.

At 48 Indianapolis Street Railway shows an advance of nearly 20 points in two weeks.

For July, Consolidated Traction, of Pittsburgh, shows a surplus of $19,534, an increase of $4,946. For four months the surplus is $59,828, an increase of $24,405.

Comparative figures for the Tampa Electric Company are given as follows:

	1901	1900	Inc.	Dec.
June gross..	$15,813	$12,270	$3,542	....
Net	6,835	5,617	1,218	....
6 mos. gross.	91,883	67,951	23,931	....
Net	39,764	28,527	11,236	....

Louisville capitalists have concluded negotiations for the construction of an electric road for Springfield, Ill., to towns within a radius of 25 miles of that city. They propose eventually to extend the line to St. Louis, Mo.

The Ferrocaril de Circunbalacion is the name of the new company which has recently been organized in the Mexican capital for the purpose of constructing and operating an extensive street railway system in that city. Mr. Arthur Stilwell and other American capitalists are said to be largely interested in the enterprise. A concession to the company has been granted by the Mexican Government which permits it to operate a line of street railway on 200 streets which are not traversed by the existing electric traction company there.

NEW INCORPORATIONS

ST. MARYS, PA.—St. Marys Electric Company. $5,000.

TOWANDA, PA.—Bradford County Telephone Company. $10,000.

PITTSBURGH, PA.—Edgewood Light, Heat and Power Company. $1,000.

DOVER, DELA.—The Nomadic Street Lighting Company of New York. $100,000.

OLIN, IOWA—Olin Light and Power Company. $5,300. Incorporators: F. E. Austin and others.

NEW YORK, N. Y.—W. F. Irish Electric Company. $75,000. Directors: T. M. Belknap, F. M. Clute and others.

HARRISBURG, PA.—Monaco, Aliquippa & Coraopolis Street Railway Company. $72,000. To build a line 12 miles long.

LAWTON, OKLA.—The Red River Telephone Company. $50,000. Incorporators: Jacob Roberts, W. J. Steele and others.

RUTLAND, VT.—The La Salle & Marshall County Telephone Company. Capital stock increased from $50,000 to $100,000.

GREENWOOD, MISS.—Yazoo Valley Telephone and Telegraph Company. $150,000. Incorporators: Harvey Meyers, W. D. Crist and others.

LEXINGTON, KY.—The Georgetown & Lexington Traction Company. $5,000. To operate an electric line between Georgetown and Lexington.

DULUTH, MINN.—The Duluth, Virginia & Rainy Lake Railway Company. $2,000,000. To build a line from Virginia to the northern boundary line of the state.

GREENVILLE, S. C.—The Greenville-Piedmont Traction Company. $100,000 to $250,000. To construct a line from Greenville to Piedmont, a distance of 12 miles.

POUGHKEEPSIE, N. Y.—The Consolidated Electric Light, Heat and Power Company. $200,000. Incorporators: James N. Hinkley, P. Frost Spauling and others.

COLUMBUS, GA.—The Arlington & Columbus Railway. $500,000. To run from Arlington to Columbus, Ga. Incorporators: J. F. Hansen, John M. Eagan and others.

GRAND ISLAND, NEB.—City Electric Light and Ice Company. $200,000. To manufacture gas, electricity and ice. Incorporators: John S. Knox, G. H. Payne and others.

SOUTHAMPTON, SUFFOLK COUNTY, N. Y.—The Suffolk Light, Heat and Power Company. $25,000. Directors: Phillip Tillinghast, H. N. Stinert, of New York city, and others.

KLAMATH FALLS, ORE.—The Klamath River Irrigation and Electric Company. $350,000. To construct an electric light and power plant. J. F. Geller, C. C. Multie and others are interested.

MONTREAL, CANADA — The Ampere Electric Manufacturing Company. $50,000. To manufacture electrical apparatus, appliances, etc. Applicants for incorporation: C. R. Whitehead, R. E. T. Pringle and E. E. Cary, all of Montreal.

HARTFORD, CT.—The Acme Switch Company. $12,500. To manufacture and deal in devices for controlling electric currents. Subscribers: William H. Bosworth, Bristol, Vt., George L. R. Eldredge and Henry G. Cogswell, Hartford, Ct.

TROY, N. Y.—The Standard Signal Company. $300,000. To manufacture mechanical, electrical, pneumatic, and other systems of interlocking block signals and safety appliances for railroads. Directors: Alfred H. Hensaw, of Troy; Harvey N. Loomis, of New York, and others.

TELEPHONE AND TELEGRAPH

The Independent Telephone Company has asked for a franchise in Waukesha, Wis.

The La Crosse Telephone Company, of La Crosse, Mich., is planning to extend its lines from La Crosse to La Crescent Mine and Eagle Bluff.

The stockholders of the Marathon County Telephone Company, Wausau, Wis., have decided to enter the Wisconsin Valley telephone combination.

The Home Telephone Company, of New Comerstown, Ohio, has been obliged to put up 700 feet more of cables owing to the increased demand for 'phones.

The Albany New Telephone Company will soon begin business in Cohoes, N. Y. This company is the one of which the new Cohoes company is a part.

The Rex Telephone and Electric Company, of Des Moines, Iowa, is to increase its plant. This improvement has been rendered necessary by increasing business.

Frenchtown, Locktown and Baptistown, N. J., have been connected by telephone. The line is being built to Sergeantsville, from which place it will extend to Flemington.

The Chicago Telephone Company has completed plans for a telephone exchange building to be erected in North Boulevard. It will be a two-story building of pressed brick.

The Huron County Telephone Company and the New Washington Telephone Company, of Bellevue, Ohio, have consolidated under the name of the Huron County Telephone Company.

The Erie Telephone System made a net gain of 788 subscribers in July. Its net gain since January 1 is 10,804. The total connected July 31 was 152,153; those awaiting connection, 2,473.

The Bradford County Telephone Company, of Pennsylvania, has been granted a charter giving it permission to erect telephone lines and operate exchanges in Bradford, Wyoming and Sullivan counties.

A second telephone system is to be introduced into Springfield, Ohio. This system will be constructed by the Home Telephone Company which has been seeking entrance to that city for several years.

The Victor Telephone Manufacturing Company, of Chicago, Ill., has changed its name to the International Globe Company, and will now manufacture and print maps instead of engaging in the electrical business.

The capital stock of the International Bell Telephone Company, Limited, has been reduced from $750,000 to $500,000. This change was made by the filing of a certificate with the Secretary of State at Albany, N. Y.

The long-distance telephone company is gradually extending its lines through Virginia. The line between Petersburg and Manchester has been completed and connections made with the Richmond exchange.

The contract for building the Grinnell exchange in Grinnell, Iowa, has been let by the Interior Telephone Company. It is expected that the system will be in operation within five weeks. The contract price is said to be $10,800.

The Kinloch Telephone Company has begun the construction of its telephone system in Alton, Ill. A toll line will be put in operation between Alton and St. Louis, which will be free until the local exchange is ready for business.

The People's Telephone Company, of Jackson, Mich., has made a contract for the erection of a building in Jackson. The capital stock of the company has been fixed at $200,000. Among the directors are J. C. Richardson, Z. C. Eldred and others.

It is expected that a modern telephone plant will soon be constructed in Kissimmee, Fla. Senator C. A. Carson is to secure a charter from the city council, and will establish a local telephone exchange to be connected with the long-distance telephone.

A new telephone exchange to be known as the Eureka Telephone Company, is to be built in Waxhaw, N. C. Mr. H. M. Williams is president of the company. A 50-drop switchboard will be put in, and connection will be made with Monroe, Matthews and Charlotte.

Professor J. N. Fries has received the right to establish a system of telephones in Berkeley Springs, W. Va., and a stock company will be formed at once to put the system in operation. This system will extend to different parts of the country and connect with neighboring counties.

Henry Shenk has received the contract for the new court exchange building of the Central District Printing and Telephone Company, of Pittsburgh, Pa. The specifications call for a three-story brick structure to cost about $75,000.

The controlling interest of the Citizens' Standard Telephone Company, of Kingston, N. Y., has passed to the American Construction and Trading Company, of Elyria, Ohio. The price paid was $50,000. Many thousand dollars will be spent in improving and extending the telephone system.

Communication by wireless telegraph has been set up between Nantucket, Mass., and the South Shoal lightship. The system is working to the entire satisfaction of Commander J. D. J. Kelly, who has been in charge of the installation. Between Siasconset and the lightship numerous messages have been exchanged.

The American Telephone instrument statement for the month ended July 20 shows:

	1901.	1900.	1899.	1898.
Gross output.....	56,526	65,463	48,873	21,551
Returned.....	30,241	30,093	18,028	10,011
Net output.....	26,285	35,370	30,845	11,540
Since Dec. 20:				
Gross output.....	526,449	411,609	389,899	187,880
Returned.....	224,810	162,753	109,765	83,306
Net output.....	301,639	248,856	280,134	104,578
Total outstanding.	2,254,455	1,829,361	1,405,384	1,023,694

Strouse Brothers have completed a telephone line from Warsaw to Wabash, Ind., a distance of 40 miles. This line was started late last fall at Milford, Ind., a point 16 miles north of Warsaw, but was stopped in December on account of cold weather. By this line a gap has been closed and Indianapolis now has service to the northern part of the state over the independent lines.

A new feature has been inaugurated in Rochester, N. Y., by the general manager of the Bell Telephone Company, H. W. Pope. The names of the subscribers and the number of the subscribers' stations will be published in the daily papers when each station is installed. In this way the necessary delay arising in the publication of the telephone directory, which generally occupies a whole month, will be obviated. This will undoubtedly prove of great benefit to the subscribers while the directory is being published.

The Memphis Telephone Company, of Memphis, Tenn., which represents the independent system, has won the first decision in the fight between the two rival companies. Judge Hammond has refused to grant the injunction asked for by the Cumberland Telephone Company, the representative of the Bell system. He ruled that the application for an injunction to restrain the new company from interfering with the manholes of the latter's conduit system was groundless, since the matter could be settled by an action for damages.

PERSONAL MENTION

MR. H. BEVES, of the General Electric Company, Limited, England, has just sailed for Europe after a short visit to the United States.

PROFESSOR MICHAEL I. PUPIN, of Columbia University, whose house in Yonkers, N. Y., was recently entered by burglars, states that none of the drawings of electrical inventions upon which he is engaged has been stolen. All the drawings were in a safe deposit vault in New York.

MR. CHARLES E. BROWN, secretary of the Central Electric Company, Chicago, has returned from a month's sojourn in Europe. Mr. Geo. A. McKinlock, president of the same company, is spending a few days in New York, and reports the electrical supply business of the West as very active.

CAPTAIN T. H. BRADY, of New Britain, Ct., was a New York visitor last week. Captain Brady is the pioneer manufacturer of mast arms for electric light and railway companies, and in addition does a large business in are cutout boxes, pole hoods, steel proof pulleys and all classes of brackets. The demand for his product continues to increase.

HON. P. C. BURNS, president of the American Electric Telephone Company, of Chicago, spent a few days in New York city this week. Mr. Burns is very properly elated over the fact that his company has just secured the order for 8,000 sets of instruments from the Keystone Telephone Company, of Philadelphia, which is believed to be the largest order of the kind ever given in this country.

SENOR ANGEL OLAZAGASTI, who is the superintendent of the city electric lighting plant at Ponce, Porto Rico, is at present in the United States. He is making an inspection of the latest improvements in American electrical machinery, and expects to put through some purchases of new equipment for installation in the Ponce plant. At last advices Senor Olazagasti was in Columbus, Ohio.

GENERAL EUGENE GRIFFIN, vice-president of the General Electric Company and director of the British Thomson-Houston Company, has arrived from Europe. He will not remain long on this side, as the business of the British company will occupy a large portion of his attention for some time. The work on the British Thomson-Houston Company's new plant at Rugby is steadily progressing, and the plant, it is believed, will be in active operation during the latter part of next year.

LEGAL NOTES

ROAD-BEDS AND TROLLEY POLES TAXABLE AS REAL ESTATE—It has been decided recently by the Supreme Court of New Jersey that the road-bed, rails, poles, stringers and wires of trolley lines which occupy the public streets or highways, are real estate, and as such taxable. This decision is a radical departure from the usual way of treating corporations in New Jersey.

A BILL OF COMPLAINT against the Chicago Rheostat Company, of Chicago, Ill., and the General Incandescent Arc Light Company, of New York, has been filed by the Cutler-Hammer Manufacturing Company, of Milwaukee, Wis., in the United States Circuit Court. The bill states that certain patents covering the inventions of Harry H. Blades pertaining to electric switches for motors were assigned by the inventor to the Detroit Motor Company. This company, in turn, contracted with the Cutler-Hammer Manufacturing Company for the exclusive manufacture of said patents. The defendant companies are alleged to have been manufacturing and selling certain switches that are an infringement of these patents, for the last six years.

ELECTRIC LIGHTING

The people of Mansfield, Mass., have voted to build an electric light plant.

The work of building a large electric light plant at the Buchanan Dam in Niles, Mich., has been commenced.

A 10-year franchise has been granted to J. M. Sparks, of Staunton, Va., for an electric lighting plant.

The people of Castleton, N. D., are considering the question of issuing bonds for an electric light plant.

In Farmville, Va., the Electric Construction Company has been awarded the contract for building an electric lighting plant.

In Montesano, Wash., a new electric light plant will be installed in September. The current will be generated by water power.

The city of Mascontah, Ill., is about to make a new contract for electric street lighting. Bids are wanted until September 16.

The lowest bid for the new electric lighting plant in Lewes, Del., was received from Sheehan & Company, of New York city. It was $12,856.

The general contract to erect an electric lighting plant at the State University of Minnesota has been granted to R. McMillan & Company.

Mr. J. H. Bourse, of Philadelphia, has received the contract for building the powerhouse at Relofs, Pa., for Henry H. Relofs, of Philadelphia.

Permission has been asked for by William J. McEathurn and Clayton A. Gates, of Omaha, Neb., to build a power plant near Fullerton, Neb., to cost $19,500.

It is reported that Captain F. N. Seibery, of Nome, Alaska, has purchased apparatus for a plant for the Nome Electric Light and Power Company to cost about $25,000.

Rumor has it that the Fremont Electric Light Company, the Fremont Gas Company and the Creager Light Company, of Fremont, Ohio, will soon be under one ownership.

Plans are being prepared by M. Spitzer for an electric light and power plant for the Canton-Akron Electric Railway Company, at Akron, Ohio. This plant is to cost $50,000.

News comes from Orrville, Ohio, that the citizens will soon vote on the question of bonding the village to the extent of $15,000 to defray the expenses of installing an electric light plant.

John Wanamaker has awarded the contract to build a $10,000 power plant at the northeast corner of Broad street and Washington avenue, of Philadelphia, to William Steele & Sons.

Robert T. Chickner, of Watertown, N. Y., and J. R. Crawley, of Helena, have secured the water rights at Hastings Falls. It is proposed to build a power plant which will develop about 10,000 horse-power.

A special election will be held in Harrisonburg, W. Va., to decide the question of the installation of a municipal electric light plant according to plans prepared by Engineer Thorburn Reed, of New York.

Mr. John L. Bright, the manager of the Citizens' Electric Company, of Lewistown, Mont., has purchased a lot for the erection of a new electric lighting plant. Work will commence upon it as soon as the plans have been completed.

Bids are open for the rebuilding of the electric lighting system and the installation of additional machinery at the power station of the municipal lighting plant in Sharpsburg, Pa. This was made necessary by the demand for more lights.

A short time ago the plant of the Mount Pleasant Electric Light and Power Company, of Mount Pleasant, Tex., was destroyed by fire. The loss, which was partially insured, was about $6,000. By this fire the town was left in darkness.

Bids are being asked for until August 5 by the city of Port Arthur, Ontario, for constructing a timber dam on the Corn River and about 1,900 feet of wood staves, pipe, concrete work, etc., for a power plant. J. M. Neiland, of Montreal, Quebec, is engineer.

The Point Pleasant Light Company has received permission to string wires in the borough of Bay Head, N. J. Vice Chancellor Grey in 1896 filed an opinion to the effect that municipal consent for the erection of poles and wires did not apply to boroughs.

The stockholders of the Oshkosh Electric Light and Power Company, of Wisconsin, will meet to reorganize the company preparatory to rebuilding the plant and rewiring the city to supply it with light for the next 10 years. The company will be recapitalized, but at what figure has not yet been decided.

The United Railways and Electric Company's new generator station has been finished in Baltimore, Md. Every idea of steam engineering practice which stands for efficiency, economy or safety has been embodied in its construction. The station was planned and built under the supervision of Mr. P. O. Keilholtz, consulting engineer of the company.

Two contracts have been awarded in connection with the new lighting plant for the Department of the Interior at Washington. The Heine Safety Boiler Company, of St. Louis, will furnish the boilers, at a cost of $12,898; and the Ridgway Dynamo and Engine Company, of Ridgway, Pa., will supply the dynamos and engines, the cost of which will be $14,950.

The chancery court has appointed a temporary receiver for the East Tennessee Light and Power Company, of Athens, Tenn., at the instigation of the Knoxville Electric Light and Power Company, *et al.*, claiming that the company is insolvent and unable to conduct its affairs. The company furnishes the electric lights for Athens and was supposed to be conducting a successful business.

The Tiffin Light and Fuel Company, the Tiffin Electric Light Company and the Tiffin Gas Light Company, of Tiffin, Ohio, have been consolidated. The new company will be known as the Consolidated Gas and Light Company. It will also own plants in Delphos, New Bremen and Minster. Among the incorporators of the new company are: M. B. Daily and C. F. M. Niles, of Toledo.

Sealed proposals, in duplicate, will be received at the office of the Board of State Capitol Commissioners, No. 512 Endicott Building, St. Paul, Minn., until 12 o'clock noon, September 24, for all labor and material required for the mechanical equipment and power-house for the new State Capitol Building, at St. Paul, Minn. These proposals must be made on forms which will be furnished by the board.

The United Electric Light Company, of Springfield, Ohio, has purchased land upon which a large storage battery plant will soon be erected. The company needs such a plant to store up the electricity which it obtains from the water power in Indian Orchard in the daytime. With a big capacity for storage the Indian Orchard plant may be kept running in the daytime to fill the batteries, and at night can be used on the regular circuits, in addition to the supply from the storage batteries.

ELECTRIC RAILWAYS

The Easton-Nazareth trolley road of Easton, Pa., will be extended from Nazareth to Bath.

Another trolley line to run from Boiling Springs to Mount Holly, N. J., is being projected in Cumberland County.

Mr. Robert Cornell, of Clayburne, Tex., has applied to the city council for permission to build a street railway system in Clayburne.

News comes that the British Columbia Railway Company, of Vancouver, British Columbia, will expend $100,000 in improvements upon its system.

A site for its power-house has been secured by the Hazleton & Wilkesbarre, Pa., trolley road. It is about midway between Hazleton and Wilkesbarre.

The Brady Syndicate—Joseph C. Brady, W. S. Brady, Joseph Handlan and others—has applied for a franchise for a street railway in Fort Worth, Tex.

The charter of the Northern Ohio Electric Company, of Defiance, Ohio, has been amended so that it can extend its route from Defiance to St. Mary's.

It is stated that the Portland Street Railway Company, of Portland, Me., will further enlarge its system by extending its road from Saco to Ferry Beach Park.

The Union Traction Company, of Philadelphia, Pa., has filed plans for power-house No. 8, to be built at Wyoming avenue and K street. It will be 76 by 80 feet.

Franchises will be granted by the city of Waynesboro, Ind., to the Chambersburg, Green Castle & Waynesboro Street Railway Company to run its lines through Waynesboro.

The New York Ship Building Company, of Camden, N. J., will build a trolley line from its works through a number of streets of the city for the convenience of its workmen.

A franchise has been granted by the citizens of Canajoharie, N. Y., to the Mohawk River Traction Company, to construct a street railway through the streets of the village.

New York capitalists are looking over the route of the Frawley, Bundy Wilcox Railroad in Wisconsin. After this review of the plans is completed, actual work on the road will be commenced.

The contract for the construction of the street railway line between Parkersburg, W. Va., and Marietta has been let, but the name of the contractor has not yet been made known.

The Powers-Colvin Company, owners of the Saratoga traction line, are securing rights of way for an extension of their road from Ballston to Mechanicville, N. Y. The route has already been surveyed.

The city council of Wapakoneta, Ohio, has extended the franchise of the Western Ohio Electric Railway Company, which desires to extend its lines south on Blackhoof street to the corporation line.

The work on the construction of the new Cadiz-Bridgeport line, of Ohio, has been begun by Contractor Sells at the Bridgeport end of the line. From this time on work will be pushed as rapidly as possible.

A franchise has been granted to the Mohawk River Traction Company, of Fort Wayne, N. Y., to construct an electric railroad through the streets of Fort Plain. The franchise is limited to August 1, 1903.

The people of Alhambra, Cal., have only to raise $12,500 if they desire rapid transit to and from Los Angeles. If this condition is fulfilled, the Huntington & Helman Syndicate stands ready to gratify their desire.

Work will be commenced inside of three weeks upon the road-bed of the railway from Genesee to Orleans, N. Y. Operations will begin simultaneously in the Tonawanda Swamp and between Albion and Point Breeze.

A force of some 300 men has begun work on the extension of the St. Charles Street Railway Company, of New Orleans, La. This is only one of the several extensions and improvements which this railroad is making.

The Urbana, West Point & Yorktown Railway Company, of Yorktown, Va., is securing rights of way for an electric railroad across the country from Toano, on the Chesapeake & Ohio Railroad, to Urbana in Middlesex County.

The lines of the electric light company, of Monterey, Cal., will be extended to Pacific Grove and New Monterey on one side and Oak Grove on the other side of Monterey. This movement will entail a large expenditure of money.

The Columbus, Delaware & Maryland Electric Railway Company, of Delaware, Ohio, has received a franchise to construct an electric railway from the county commissioners. The company is at present securing property rights.

It is reported that W. G. Henshaw possesses a controlling interest in the Oakland, San Leandra & Heywards Electric Railroads, of Oakland, Cal. It is believed that the Heywards road will soon be acquired by the Oakland Transit Company.

The underground electric system of the Metropolitan Street Railway upon its Seventh avenue line will be put into service within two weeks. It is expected that this road will be the fastest surface line in New York city, as the traffic on Seventh avenue is very light.

A certificate of the extension of the road of the Greenwich & Schuylkill Electric Railway, of Schuylkill, N. Y., has been filed with the Secretary of State. The branch which it is intended to build will extend northerly to Baldwin street in the village of Fort Edward.

The Milford & Upton Electric Railway, of Upton, Mass., has received a franchise from the selectmen of Upton to construct a railway there. A deposit of $5,000 is required when the construction is begun, and the line is to be completed and in running order by January 1, 1902.

The Western Ohio Electric Railway Company intends to build 70 miles of additional track by way of Lima to Findlay and from Wapakoneta south 30 miles, Sidney to Piqua 30 miles, and from St. Mary's west to Celina 10 miles. To do this it will increase its capital from $1,000,000 to $2,500,000.

The county commissioners of Ohio have amended the franchise granted to H. R. Young for an electric line. The amendment includes the provision that work on the line must be commenced by April 1, 1902, and must be completed by April 1, 1903, unless further time is granted by the commissioners.

The State Railroad Commission of New York State is considering an application for permission to construct an electric railroad from Golden Bridge, in Westchester County, to the Connecticut state line near Danbury. The proposed road will give Danbury an outlet to the Harlem road by the construction of a short connecting link.

Good progress has been made upon the construction of the new electric road between Albany and Schenectady, N. Y., and it was expected that it would be open to travel by August 15. The new route connects with the lines of the United Traction Company at West Albany and with the Schenectady railway lines in that city.

The gentlemen interested in the railway to extend from Rochester to Hornellsville, N. Y., have held a meeting. An offer made by representatives of New York capitalists and contractors to build and equip the road was accepted. The directors of the company will now proceed to procure village and town franchises at once.

A meeting of the stockholders of the Jersey City, Hoboken & Paterson Street Railway Company will be held in Hoboken, N. J., to ratify the action of the directors in guaranteeing $1,000,000 of first mortgage bonds issued by the Bergen Turnpike Company, for the purpose of building a trolley line from Hackensack to Hoboken.

The Big Four Railroad is planning to construct a power plant at East Alton, Ill., to operate all the switches of the interlocking system of the Alton and Big Four, between East Alton, Wann and East St. Louis, where the two roads running parallel are operated as a double-track system. It is the plan to light all the semaphores with electricity.

The Port Chester Street Railway Company, of Port Chester, N. Y., and the Larchmont Horse Railway Company have filed articles of consolidation with the Secretary of State. This new corporation will be known as the New York & Stamford Railway Company. The capital stock is $500,000. W. H. Campbell and William Murray are among the directors.

The citizens of La Habra, Cal., and La Habra Valley have subscribed a considerable amount of money and secured right of way for the new Los Angeles & Santa Anna electric line, which was to run from Fullerton to La Mirande, and thence to Whittier, leaving La Habra Valley off the main line. The people are anxious to have the road changed to come direct from Fullerton to La Habra, thence to Whittier.

The incorporators of the Stafford Springs Street Railway have effected an organization. Thomas C. Perkins, of Hartford, Ct., was elected president. The above company has taken the initiative step for a through trolley line from Hartford, Ct., to Boston, Mass., in connection with the Hartford, Manchester & Rockville Tramway Company, of Rockville, Ct. The Stafford Springs Street Railway will run from Rockville to the state line.

The Everett-Moore Syndicate, which controls a number of electric railways in Ohio and Michigan, is going to establish a package and freight-carrying system of its own. It already has the system well under way, but it is in the hands of the local package carriers. The Everett-Moore Syndicate is using every means possible to rush work on its other electric line between Cleveland and Detroit. Mr. Everett states that it is the expectation that it will be running through trains over the line by Christmas.

The first car to run over the tracks of the Greenwich Tramway Company has been taken across the new Hawthorne bridge and for a mile into Connecticut. President Singer, with other officials of the New York & Stamford trolley line, and about 40 guests, were on the car. Among the latter was William H. Mead, of Greenwich, who was a passenger on the first train that ever ran on the New Haven Railroad, on Christmas day, 1848. Within a month the cars of the new tramway line will be going into Greenwich, the entire road being almost completed.

AUTOMOBILE NOTES

The cartage bill of Boston, Mass., in the course of a year is said to be not less than $10,000,000, which shows that there is an enormous field for automobiles there.

An automobile trip from St. Louis to New York will be made by Oscar L. Halsey and J. D. Perry Lewis. They expect to reach their destination in 10 days. The route followed will be selected from the official map of the League of American Wheelmen.

The first arrest under the new ordinance which limits the speed of automobiles to six miles an hour upon the street in Rhode Island has occurred. The machine of Robert H. Collier, of New York, was stopped while running at the rate of 15 miles an hour. Albert Dennis, the *chauffeur*, was in charge. According to his statement he made a run of eight miles in 11 minutes. Dennis was held for trial under $500 bonds.

The automobile races at Newport, R. I., are to occur after all, despite considerable opposition. The city council of Newport has given permission to use certain parts of the ocean drive on August 30 for automobile races. Mr. William K. Vanderbilt, Jr., president of the National Automobile Racing Association, has worked for the scheme personally and secured the signatures of several of the cottagers to the petition. For these races both Mr. and Mrs. William K. Vanderbilt, Jr., have offered cups, one of which will be for the championship of America. Mrs. Herman Oelrichs and Mr. and Mrs. Oliver H. P. Belmont in all give five cups. This will be the first occasion that Mr. Vanderbilt's new German racer will be seen in a race. He is so confident that he has the fastest machine in America that he is going to write letters to all the owners of fast machines in this country to meet him on that day. Albert C. Bostwick will, at that time, have a chance to try conclusions with Mr. Vanderbilt, and undoubtedly other fast machines will be present for the race, which will be the only one of the kind that has ever been held in this country. Not only will fast gasoline engines compete, but there will be races for all makes and styles of automobiles.

The British Automobile Club has organized a tour of Scotland, on the occasion of the Glasgow Exposition, which is of great interest. The tour, which will be of 500 miles, will begin September 2, and last five days. Among the points to be considered in the test are the price of the vehicle, its weight, the capacity of the motor, the number of persons or the weight transported, the price per horse-power, price per person transported, force in proportion to the weight, the extra power of the motor and the flexibility of the mechanism as shown in the mounting of grades, and the simplicity of the transmission devices. Among other points are the value of the steering devices and of the mechanical parts, the ignition of the motor, appearance of the vehicle, its condition after the trip, stops and accidents, etc. As will be seen, the programme is of a distinctly practical nature. Five different tours are to be made. On the first day, Glasgow-Edinburgh and return, or 116 miles. Second day, Glasgow-Ayr and back, 108 miles. Third day, Glasgow-Callander and back, 96.5 miles. Fourth day, Glasgow, Stirling, Glen Devon and return, or 95.5 miles. Fifth day, Glasgow-Clianlarich and back, or 116 miles. Each firm has the right to enter two vehicles of the same size and make; racing machines will be excluded, as this is exclusively a touring race. Another event is the tour of Ireland, which is organized for the month of August. A number of leading *chauffeurs* are engaged. The trip, starting from Dublin, will last 15 days, and the public will have an opportunity to inspect the machines upon their return to Dublin.

INDUSTRIAL ITEMS

THE ELECTRIC APPLIANCE COMPANY, Chicago, is being kept busy filling orders for the Eaco hotel telephone and annunciator systems.

THE McGUIRE MANUFACTURING COMPANY, of Chicago, Ill., has recently received a contract from the London United Tramways Company for 170 trucks.

PETTINGELL & COMPANY have sent to the ELECTRICAL REVIEW their desk book of printing types. It is a very complete specimen book, handy for reference and evidently up to date.

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, of Providence, R. I., has recently received an order for its specialties from South Africa for the Cape government railway service.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., is distributing blue printed postal cards among the street railway companies, which are of interest to those intending to install the chloride accumulator.

THE SPRAGUE ELECTRIC COMPANY, of New York, announces its outlet boxes and plates for interior conduit and cables. Over 1,800 different styles are manufactured, and it is intended that every condition shall be provided for.

THE PARAGON FAN AND MOTOR COMPANY is sending out bulletin No. 65, illustrating and describing the Paragon sewing machine "transmitter" for direct and alternating current. It describes the system of operating sewing machines by means of electric motors.

MR. J. E. LLOYD, manager of the Cape Town Electric Traction System, is at present purchasing quantities of electrical and miscellaneous supplies in the American market. The Morris Electric Company, of New York city, has received orders for several thousand incandescent lamps of 16 candle-power.

WYSS & COMPANY, of Zurich, electrical engineers, have secured a contract to supply all the machinery for the new electric installation at Niagara Falls, which will consist of 11 turbines of 55,000 horse-power each. Mexico has placed an order for an electric station of 100,000 horse-power with the same firm.

MR. GEORGE INNES, a mechanical and electrical engineer, whose address is P. O. Box 2,127, Marshall Square, Johannesburg, South Africa, is desirous of entering into communication with American firms which would quote him prices and furnish particulars regarding boilers, engines, dynamos, generators, motors and transformers.

THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, LIMITED, is reported to have given the contract to Jones & Laughlin, Limited, of Pittsburgh, Pa., for all the necessary power transmission machinery, which comprises shafting, pulleys and hangers, to be installed in the Manchester plant of the British concern.

THE FRANKLIN MACHINE WORKS, Incorporated, of Philadelphia, Pa., is sending out a very attractive June catalogue. This catalogue contains very elaborate descriptions of its horizontal boring machines, milling machines, cold saw cutting-off machines, etc., which will be found very useful to those who have occasion to purchase such machinery.

THE MUNICIPAL COUNCIL, of Launceton, Australia, has awarded a contract to the Diamond Meter Company, of Peoria, Ill., to furnish watt-hour meters of the induction type, which are to be utilized in the electric lighting system of that city. This contract was awarded in the face of British and Swiss competition. It called in the first instance for 500 meters.

THE SAFETY ARMORITE CONDUIT COMPANY, Rankin Station, Pa., manufactures the "Loricated" electric iron armored conduit for interior construction. The company is the sole manufacturer of the "Loricated," "Armorduct," and "Armorite" conduits, and will mail illustrated literature to engineers, contractors and architects, on application.

THE WALLACE BARNES COMPANY, Bristol, Ct., is completing an addition to its factory of 110 by 36 feet. This company is also installing new machinery and will be enabled to produce even a better quality of goods more promptly than in the past. It manufactures springs of every description, and deals in wire and cold rolled steel. The company desires to quote prices to all persons using springs of all kinds.

THE MARINE REVIEW PUBLISHING COMPANY, of Cleveland, Ohio, has completed the 1901 edition of the blue book of American shipping, which it issues annually. It is a standard work on water commerce in America from a statistical standpoint, and deals with every branch of shipping. It contains the names and addresses of ship owners, shipbuilders, naval architects, marine engineers, admiralty lawyers, steamship lines, ship chandlers, etc.

THE WHEELER CONDENSER AND ENGINEERING COMPANY, 120 Liberty street, New York city, is to furnish most of the new apparatus required for the extension of the Manila electric light plant, including condensers, pumps, heater apparatus and a cooling tower. The plant, when completed, will have a capacity of 2,500 horse-power. A large steel stack for the new works will be made by the Philadelphia Engineering Works, of Philadelphia.

THE J. G. BRILL COMPANY, of Philadelphia, Pa., has secured a contract, through its London representative, Mr. Marskelle E. Curwen, for a number of single deck closed car bodies mounted on trucks; also for several very long closed bodies mounted on trucks. This contract is being undertaken on behalf of the Kalgoorlie Electric Tramway, Kalgoorlie, West Australia, for which system American manufacturers have secured the most important contracts.

THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, LIMITED, has placed a contract with the Binsse Machine Company, of Harrison, N. J., for the horizontal boring equipment to be installed in its new works, which are now being built at Trafford, near Manchester, England. The contract includes three six-foot double machines, and the same number of double-head machines, which will be utilized for boring street-car motor frames.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently gotten out, under its own name, a new dry battery called the "Wesco." The battery is meeting with an extremely flattering success, as the demand for it is very large. This company is also getting out a new brand of friction tape called "Wesco," and states that this tape is to fill a long-felt demand for tape which is moderate in price, and at the same time comparatively first-class.

THE GOSHEN RUBBER WORKS, Goshen, Ind., is sending out a sample of its rubber tape, sometimes called splicing compound. It is announced that this is the only rubber tape that will vulcanize by exposure, thus forming a perfectly water-tight sleeve over the joint. This tape has been made by the Goshen company for 12 years past, and during that time no complaint has ever been received. The tape is shipped in half-pound boxes.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., call attention to the fact that instruction is given throughout the entire year, the vacations of the principals and instructors being arranged so that there is no interruption in the work of the schools. This affords an opportunity for mechanics and others who have a dull season during the summer to take up a course by mail and make good use of what would otherwise be waste time.

THE ROCHDALE CORPORATION, England, has ordered three electric cars each from the British Thomson-Houston Company and the English electrical engineering and contracting firm of Dick, Kerr & Company. These cars have been ordered for experimental purposes. The ultimate contract will call for over 50 cars. The British Thomson-Houston cars will be largely, if not entirely, of American manufacture. The cars ordered from the Dick-Kerr people will be built in their works.

THE B. F. STURTEVANT COMPANY, Hyde Park, Mass., is erecting its new plant, to consist of an engine and electrical shop, of galley type, 120 feet by 40 feet; two buildings, each 80 feet by 400 feet, and three stories high, for blowers, heaters, forges, galvanized ironwork, exhaust heads, etc., and a foundry 120 feet by 400 feet. In addition, independent office, power and pattern storage buildings are planned, and will be of fireproof or slow-burning construction, thus reducing the fire risk to an absolute minimum.

THE DAYTON INSULATING VARNISH COMPANY, of Dayton, Ohio, manufactures the Dayton insulating paint as well as the Dayton insulating varnish. The company is owned and operated by Messrs. W. I. Wuichet, H. A. Baldwin and C. S. Troup, the last-named gentleman being the general manager of the company. The Dayton insulating varnish is pronounced an ideal insulating compound, contains no acids, and will not corrode. It is adapted for use on armatures, field magnets and bare metal surfaces. Testing samples are furnished free to companies desiring the varnish for this purpose.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York, and 188 Fifth avenue, Chicago, has issued illustrated catalogue No. 12, covering electric light, household, telephone, telegraph and railway electric supplies. The catalogue is a massive and comprehensive publication of nearly 500 pages, and is profusely illustrated throughout. The Manhattan company has large factories in Jersey City, N. J., which have been enlarged from time to time until its manufacturing facilities enable it to supply goods of the best quality with great promptness. This company's catalogue will be an addition to every electrical man's desk.

YOUNG MEN'S CHRISTIAN ASSOCIATION EDUCATIONAL WORK—Few people outside those immediately interested realize the growth and extent of the educational work carried on by the Young Men's Christian Association. Standard courses are maintained by international examinations. Its pupils are of all conditions and classes of men. There are 27,000 men spending on an average 48 hours of recitation each season, or double the number of 10 years ago. Last year, it seems, 1,520 certificates were won by men in 115 different associations, the movement having so developed in organization and in standard of work done that 110 colleges and universities recognize these certificates for matriculation. In addition to its concerted evening school movement, the association wields a powerful educational leverage in its libraries and reading rooms.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED AUGUST 13, 1901.

680,233 Electrical coulomb-meter; S. E. Doane, Marlboro, Mass.—A coulomb-meter, provided with means for giving simultaneous, comparative indications of the volumes of the liberated gases.

680,236 Regulation of dynamo-electric machines; H. Edwards, Schenectady, N. Y.—A main machine, an auxiliary regulating machine driven at constant speed, and means responsive to variations in relative motion of said machines for producing a regulating current, and means for controlling by said current the field strength of said main machine.

680,242 Incandescent electric lamp; H. Gilmore, Boston, Mass.

680,251 Electrical conduit and box; H. Krantz, Brooklyn, N. Y.—An electrical conduit-box, with a split connecting neck formed with internal projections in combination with the pipe end, having external projections to engage therewith, the box having an internal stop-shoulder at the inner end of the connecting neck.

680,262 Thermo-electric regulator for valves or dampers; W. E. Mack, Oswego, N. Y.

680,265 Current-collecting device; W. S. Moody, Schenectady, N. Y.—A collector with a collector-ring, an annular contact ring having an extended surface and adapted to be pressed against substantially the entire periphery of the collector-ring.

680,266 Process of preparing rubber adulterant; W. V. McManus, New York, N. Y.

680,277 Electrical conductor; E. D. Priest, Schenectady, N. Y.—An armature-conductor, formed of a longitudinally-folded sheet-metal strip.

680,316 Timed electric switch for multiple-rate meter system; F. R M. Cutcheon, St. Paul, Minn.—A rotary head, a plurality of contact-rings carried thereby, at least one of which rings is formed by insulated sections, means for electrically connecting certain of the sections of said sectional ring with a cooperating member of said rings, and leads having brushes working on said contact-rings.

680,317 Electric brake-release; E. E. Darling, Anaconda, Mont.

680,336 Electric switch; G. E. Linton, Worcester, Mass.

680,408 Apparatus for use in elec-

(Continued on page 32.)

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PATENTS.

(*Continued from page 31.*)

tro-deposition of metals; S. O. Cowper-Coles, Westminster, England.

680,421 Transformer; F. C. Sutter, Pittsburgh, Pa.

680,440 Electrolytic apparatus; B. E. F. Rhodin, Sault Ste. Marie, Canada.

680,441 Electrode for electrolytic cells; B. E. F. Rhodin, Sault Ste. Marie, Canada.

680,505 Autotorpedo; H. Shoemaker, Philadelphia, Pa.

680,532 Secondary electric clock; F. Lucking, Detroit City, Minn.

680,535 Apparatus for charging storage batteries of automobiles; J. B. Meriam, Cleveland, Ohio.

680,590 Electrical signaling apparatus; F. B. Herzog, New York, N. Y.—An electric step-by-step motor, a wheel driven thereby, circuit connections normally through the wheel thereof and two or more insulated points thereon, each arranged and adapted to control an effect at the receiving station.

680,597 Dynamo-electric machine and electric motor; H. F. Joel, London, England.

680,614 Photophonograph - photophone; J. Poliakoff, Charlottenburg, Germany—Means for producing sound-modified light, devices for vibrating a reflected ray of such, and means arranged to receive said rays to affect an electric current.

680,618 Electric automobile motor; C. Richter, Camden, N. J.

680,619 Electric traction motor; C. Richter, Camden, N. J.

680,626 Electrical switch-operating mechanism; C. B. Russell, Marlboro, Mass.

680,629 Electric belt; J. Trussell, Chicago, Ill.

680,636 Device for lighting lamps by electricity; H. M. Brigham, New York, N. Y.

680,652 Circuit-breaker; L. L. Elden, Boston, Mass.

U. S. ENGINEER OFFICE,
735 N. Capitol St.,
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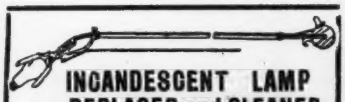

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